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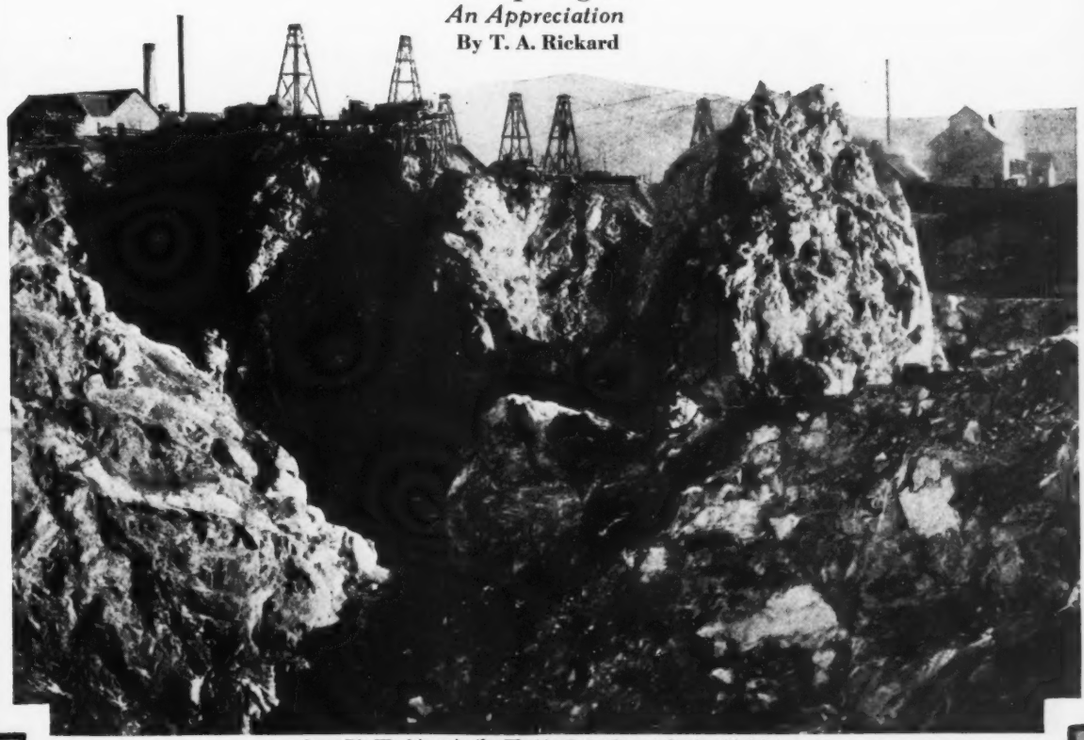

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April 15, 1922

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Volume 113 | New York, April 15, 1922 | *Number* 15

Recognition of Mexico

AMERICANS who are mining or who are desirous of mining in Mexico would like to have all possible done to promote stability. They would like to see the United States use its friendly influence to that end. Many of them would like to see the Government at Washington formally recognize that at Mexico City, believing that President Obregon has shown capacity for maintaining a stable and increasingly orderly government. The reports which come to us from time to time, from mining men, as to conditions in Mexico, are moderately favorable. The country is still industrially almost prostrate, as the result of the long years of internal war and banditry; but it is agreed that the tendency is toward improvement and that the present administration is doing pretty well.

The policy of the Government in Washington is not that of a few years ago: we do have a foreign policy; we recognize that we have part in and are affected by the conditions of other peoples than our own. Our Government will, therefore, do everything that it can toward aiding the prosperity of Mexico and in assisting those Americans who are engaged in mining enterprises there. The State Department, according to trustworthy reports, is willing to recognize the present government in Mexico, provided the usual preliminaries and mutual agreements are made, preferably in the form of a treaty. There is one clause in the new constitution of Mexico— Article 27—which in effect confiscates the property of certain Americans in Mexico by declaring that the oil in the oil lands is the property of the state, although these lands have been obtained by private purchase from individual Mexican owners. No real attempt has been made to enforce this action: nevertheless it stands as a threat. It is admittedly a difficult and perplexing problem for the Mexican government, whose minerals are otherwise held to be the property of the state, and are held by individuals or companies only so long as they pay the stipulated rental in the form of taxes.

Just as Mexico is puzzled and disturbed over the petroleum situation, which must look to President Obregon as if foreign capital were obtaining sovereignty over one of Mexico's greatest sources of wealth, the Government in Washington, whose mining law gives away its minerals in perpetuity, is unable to see any foundation for the Mexican attitude. It is a misunderstanding that could be cleared up and adjusted by frank conversations, not by stilted diplomatic notes. With these matters discussed and boiled down to a common agreement, a treaty would be possible which would bind the friendship of the two nations. Such overtures should come from the Mexican government; and if made frankly and fairly, as we have no doubt they would be, there is no question whatever of a highly satisfactory outcome.

Another Assessment Work Bill

SENATOR STANFIELD, of Oregon, could have done better than introduce, as he did on Feb. 20, a resolution to suspend the requirements of annual assessment work on mining claims during "the years 1920 and up to and including June 30, 1924." There were never more than two reasons for the suspension of the assessment law. These were, briefly, the absence of the claim holder in service during the war, and, second, the difficulty in securing labor to perform the work. Neither of these conditions now exists, nor have the conditions named existed for some time.

The question has been well debated in the past whenever it has come up in Washington. Beginning with the years 1917 and 1918, when the plea that the law be suspended was unanimously granted by Congress, the matter has been brought up for discussion year after year. The law was again suspended in 1919, when at first only five claims held by an individual were exempted, this restriction being removed, however, before the year ended, so that all claims were then exempt. It was promised then that suspension would not be asked again in the future. The matter, nevertheless, was brought up in 1920, and, as a compromise, six months' extension of the time within which the work must be done was granted, so that 1920 assessment work was being performed until July 1, 1921. Then last August a bill was passed making the assessment-work year coincide with the fiscal year instead of the calendar year, which had the effect of extending the period for 1921 work by six months, or until July 1 next at noon. Thus claim holders had eighteen months to do their 1920 work and will have a similar period for that required for 1921.

It is to be noted from the foregoing that the law was completely suspended in 1917, 1918, and 1919 and that no work was necessary during those years to hold claims. But for the year 1920 the stipulated amount of work was required, and likewise for 1921, the time in which the work must be done in both of these periods merely having been extended (in the latter period incidentally) by six months. The significance of Senator Stanfield's bill, then, is seen in that it provides for total suspension of the requirements during the years 1920, 1921, and up to June 30, 1924. It is thus retroactive as far as 1920 is concerned and is a violation of the promises made in 1919 that further suspension would not be asked.

Evidently the bill was drawn in the interest of speculators, who located claims as they desired, without expense to themselves and in the hope of turning them over at a profit. The longer the period of suspension, the longer will birds of this feather flourish, and with no resultant benefit to mining. There is one bit of comfort, however, in all of this, and it is that the bill stands little chance of passing. But the more quickly it is killed the better.

The Premier Mine

PAYMENT OF A DIVIDEND of half a million dollars is announced by the Premier Gold Mining Co. This is on account of the quarter ending March 31 and is paid on a capital of $5,000,000. On Dec. 31 the company distributed $400,000 to its shareholders, but the fact was not made known until recently. The delay in publicity was caused, we understand, by negotiations for the purchase of additional claims. Those handsome dividends have followed upon the completion of the sixteen miles of tramway from the mine, in the Salmon River district, in British Columbia, to tidewater at Hyder, Alaska, at the head of the inlet known as the Portland Canal, whence the ore and concentrate are shipped to the smelters at Anyox and Tacoma.

The original claims, located in June, 1910, were acquired by Mr. O. B. Bush, who organized the Salmon-Bear River Mining Co. The prospecting that was then started proved unsuccessful, and nothing was done until the summer of 1914, when some promising ore was exposed along the outcrop. In the winter of 1915 the property was examined by Mr. Henry Krumb, who placed Mr. R. H. Plate in charge of the exploratory work. These engineers represented Mr. William B. Thompson, of New York. Sundry crosscut tunnels were driven, without, however, striking any rich ore, whereupon the bond was canceled, after about $60,000 had been spent in eighteen months. The mine became idle again.

In the summer of 1918 Mr. R. K. Neill, an experienced operator of Spokane, was induced by Pat Daly, who had been foreman for Messrs. Bush and Plate successively, to examine the mine. The result were so satisfactory that Mr. Neill bonded the mine for $100,000, and began work in the spring of 1919. He ascertained that the No. 1 tunnel, 225 ft. long and 250 ft. below the surface, had been run nearly parallel with the lode. Cuts of only 6 ft. sufficed to disclose a veritable bonanza, the assays running into hundreds of dollars per ton. Shortly afterward, a fifth interest was bought by Mr. Minor C. Keith, of the United Fruit Co., and another fifth by Guggenheim Brothers. Mr. Neill met the option price of $100,000 out of the sales of ore.

To show the richness of the ore it can be stated that 286 tons brought a return of $96,000, of which 40 per cent was in gold and 60 per cent in silver. At one time a face of ore 7 ft. high and 6 ft. wide averaged $1,000 per ton. A crosscut showed a thickness of 82 ft. that averaged $57 per ton. The silver is in the form of argentite, proustite, and stephanite, or, as a miner would say, silver glance, ruby, and brittle silver. The ore is docile; the flow sheet of the new mill includes concentration, cyanidation, and flotation. Most of the silver is recovered in the flotation froth. The grinding is done in cyanide solution. Mr. Dale L. Pitt is manager. He is to be congratulated on the results already achieved, which promise to place the Premier among the great mines of the American continent.

Caving Systems of Mining

IN A RECENT NUMBER of *Mining and Metallurgy*, J. Parke Channing discusses in an interesting manner the subject of caving systems of mining. In his opening paragraph he defines the term "caving system of mining" as "that method of removing the ore from an underground body in which the top is first attacked and mined out and the capping or roof is allowed to fall in or 'cave' and fill the space formerly occupied by the mined ore." It seems to us that this definition is not specific enough, since it would apply broadly to all methods of mining in which open spaces were left, as eventually caving of some kind results. The illustrations which Mr. Channing uses to carry his definition are extreme examples of the same kind. It is desirable to make distinction between "cover caving," meaning by this the breaking and settling down of the overlying rocks upon existing cavities, and "ore caving," in which the ore is first undercut and is then broken (caved) by the weight of the orebody and cap rock above.

As a general mining term "caving" carries with it two fundamental ideas, the incidental collapse of wall rocks and contiguous rocks and a systematic caving of the cover with or without a deliberate attempt to make the weight of the ore play a part in breaking itself from position and reducing large fragments to smaller ones. Incidental caving is consequential upon some method of mining. Caving as used to signify a method implies control and deliberate planning.

In top-slicing, there is the mining out of a block of ore which may or may not involve undercutting. Usually the ore is broken down by drilling and blasting. After a block has been mined out the supporting timbers of the room are blasted down and the cover caves. This is therefore not a caving method, because the weight of the ore is not used in mining. According to our distinction, we would relegate it to "cover caving," but prefer to use the term top-slicing. We admit that top-slicing, to be successful, implies the regular caving of the cover as the slice is retreated.

The long-wall method of coal mining is without much doubt one of the first mining methods in which roof pressures were used to "mine" the coal. Under favorable conditions little undercutting and only light pickwork are required to mine the coal, as the pressure put upon the coal face exceeds the compressive strength of the coal and breaks it down. From this extreme we can find varying degrees up to the point where the coal must be fully undercut and shot down. In all such operations, however, the cover is dropped a short distance back of the face being mined. Here is an example of "ore caving" and "roof caving."

We believe it to be desirable to limit the term "caving method" to those methods which involve more or less undercutting and the action of the weight of material and cover in the further breaking of the ore.

Mr. Channing traces out an interesting sequence in the application of the block-caving method at Miami. It represents experimentation with thin vertical pillars and then with a slab of ore in a horizontal position. A logical consideration of block caving would imply the undercutting horizontally of a relatively thin (in height) block. The height of the block and its fall through a certain distance, together with the weight of the cap rock, would act under the most favorable conditions to break up the ore. It seems to us that mining engineers have not clearly defined the conditions under which block caving is effective. The undercut space should be sufficiently high to cause a definite drop and the volume great enough to take care of the expansion of the broken ore. It need not be the full theoretical amount represented by the difference in volume between broken ore and solid ore, but it should be, let us say for a beginning, 50 per cent of it. Block caving is undoubtedly more or less gradual, and, during the process of drawing, the upper part of the block is undergoing progres-

sive breaking down. Hence our reason for saying that the volume of undercut may be a fraction of the theoretical requirement.

A relatively thin slab is required, as a thick slab would be held too firmly by the sides. In the method as applied years ago in the Pewabic mine, end-cutting of the block was practiced, and this released it to a considerable degree, but in the method described by Mr. Channing the top weight must be sufficient to shear the sides of the block. This factor acts to reduce the vertical thickness of the block. It is of interest to note that there is a close parallel between the practice at the Ruth mine and at Miami and long-wall mining. At the mines mentioned, the thin slab is not dropped as a unit, as in the Ohio and Pewabic practices, but is subjected to the downward thrust of the broken and moving capping and the broken ore. This thrust acts upon the end of the thin block. By sequentially undercutting the end of the block and retreating, the end of the block is progressively crumbled off, and as it subsides, due to drawing off through chutes, the irregular ore blocks are gradually reduced in size. This differs from the type examples of block caving represented by the practice at the Pewabic and Ohio mines and more closely approximates the long-wall mining method. We suggest that it be called "progressive block caving," rather than "block caving."

Selective Dredging

AN INTERESTING outcome of the present struggle to reduce costs in mining operations is taking place in the gold-dredging industry. Engineers are resorting to a close scrutiny of their drill logs and are discriminating in their selection of dredging ground on the basis of its gold content and ease of dredging. In a general way gold dredging has always been conducted with a reasonable distinction between pay and non-pay ground, but the lines are being drawn closer, and dredge engineers are now discussing selective dredging. This involves the drilling of additional drill holes in uncertain parts of given areas and the study of the vertical distribution of the gold, with the object of curtailing the depth of dredging whenever possible.

In one instance coming to our attention the dredge engineer has graphically represented the vertical distribution of gold content upon his working map for each test hole or pit. With this chart he is laying out the course of his dredge and specifying the digging depths in accordance with the principle of making every cubic yard dredged carry its cost and yield some profit. It is precisely by methods such as these that mining can be made to pay.

Continuity of Operation

CONTINUITY in the operation of modern cyanidation machinery is an essential to economy and efficiency. Equipment is arranged usually so that stoppage of the entire mill need not occur in consequence of minor breakdowns or normal repairs. In some operations, however, the supply of power is not dependable, and extraordinary provision must be made against accidents that may occur from this cause.

At the Hollinger cyanide plant a number of slow-speed, mechanical agitators are used to assist dissolution of the gold before subsequent treatment is begun. The need for a reliable supply of power and for adequate provision against accident will be apparent to those whose experience has included the operation of equipment of this character. The problem was solved by the installation of compressors of a novel design, and so arranged that by making minor changes they can be converted into steam engines, the induction motors then serving as generators. These reversible units have been found to constitute an insurance against serious trouble in the mill, in consequence of the complete stoppage of electric power. One unit was in service during 1921 for current-generating purposes for four months. Thus was it possible to continue cyanidation without interruption through a period during which the power company failed to meet requirements.

The design of suitable equipment is not all that is needed in mining work; numerous unfavorable contingencies must be foreseen and provision made for them. Although those who suffer from the effects of broken machinery and unfilled contracts deserve some degree of sympathy, commendation is merited by others who make extraordinary provision against the ill-effects of accident or delay; for uninterrupted operation is the keystone of industrial success.

Industrial Applications of the Flotation Process

MANIFOLD are the uses of flotation, and interesting the details when the process is borrowed, often unconsciously, for application in some phase of industry other than as a sequel to the mining of metals. Much research has been done on the deinking of printed paper, as well as on the development of an ink that would be susceptible to bleaching by an economical chemical treatment. However, the use of the carbon-base ink, which is unsusceptible to bleaching processes, has persisted; and now comes a method by which it may be removed from old papers, and by which many economies may be effected, for newspapers may thus be used almost indefinitely. In this process the old papers are shredded and macerated in water; the pulp is then heated and laundry soap is added, agitation being maintained until the oil in the ink is thoroughly emulsified. Cold water is then added, with the result that, as the heating continues, some of the soap is thrown out of solution and rises, with the oil and the pigment, to the surface as bubbles. These, carrying their load of carbon from the printer's ink, are then removed by an appropriate mechanism, or are allowed to overflow.

This invention forms another example of the separation of a mineral by the flotation process; but a long vista of legal tangles is seen ahead if an attempt be made to determine whether or not the amount of oil used in the ink amounts to more or less than one-half of 1 per cent of the carbon contained therein!

The Technique of Mining

RECENTLY, a mining engineer in conversation with us remarked that in mining considerably more attention to technical matters was needed. How is it, he said, that while adequate attention is given to the metallurgical treatment of the ore, and an organization, the metallurgical staff, is considered essential in important operations, the mine itself is allowed to go on in humdrum fashion without adequate attention to many technical details? He remarked that the mine superintendent and his foremen usually have their time so

occupied that they are unable to give adequate attention to improvements in methods, equipment, and operations.

In our opinion this general criticism is worth the attention of mine managers. Not enough technical assistants are directly concerned as fact finders in the production operations of a mine. Neither foremen nor superintendents have sufficient time to investigate thoroughly the detail of the ordinary run-of-mine work. No little attention is given to cost analysis and sampling, and surveying and even geological mapping come in for a fair share of study. These are very important; but of importance also are technical studies of drilling and blasting operations, of mining methods, of mucking, of transportation, of hoisting, of drainage, of ventilation and of wastes both in labor time and supplies.

Price and Service

IN A SMALL GATHERING in one of the engineering clubs, an experienced mining engineer was discussing the power problem at his property. He stated that the present power requirement of the property in question was approximately 1,000,000 kw.-hr. per month. The cost, let us say, was 1c. per kw.-hr., or $1,000 per month. "Usually," our engineer friend went on to say, "first consideration is given to cost, but this, after all, is secondary. It is the service that counts. Continuity of service, reliability, is a far more important consideration than cost."

There is a good point to this engineer's argument. How often do we really consider cost details in the light of the accessory facts? Cost is the most obvious factor, but when we are buying drill hose how many of us have the facts in hand on the durability, weight per foot, and efficiency as a conduit for compressed air? When we complain about power costs we seldom think of the twenty-four hour 365 days per year service that may be attained at the switchboard. A power interruption of an hour in a mine employing 400 men may mean a direct money loss of $200, or one-fifth of the power bill. A day's interruption may mean a relatively large loss in milling capacity.

Similarly, it is not the day's pay that looms as the important limiting factor of most mining operations, but the quality of the service rendered. In the purchase of supplies, power, equipment, or labor we are, if we are logical, under the necessity of having the facts on service.

The Sucker List

DON'T BELIEVE that the promoter who is directing the destinies of fly-by-night and impossible mining ventures in which the innocent or mercenary or the foolish stock buyer puts his money has complete disregard for this trusting buyer. On the contrary, he studies him most carefully, and if we are to believe one of our friends, the more experienced of these "milkers of the public" have introduced modern methods into their business to the extent of classifying prospect lists into distinct strata. In one instance the "milker" has what he terms his Class A list. This list contains the names of "suckers" who come through all the time, in amounts of from $250 up to several thousand, and on any venture. We suppose a new name belonging to this designation might become the object of lively bidding on the part of several "milkers" if it were possible to auction it off. Next to Class A is Class B. In this the owner of the name "comes through" all the time on anything, but only in small amounts. Class C includes a list on which some 20 to 30 per cent of the names will invariably "come through" in greater or less amounts of money. Class D represents a list which yields remittances from only 10 per cent of the total number.

We had suspected it before, but now we know it. There are various degrees of this "suckeritis" disease. The victims may range from the high-grade nugget type to the low-grade spotted type. Can't you see the manager of this unmoral enterprise weighing the various candidates upon his delicate balances and assigning them to the different divisions of his mailing list? We can imagine his joy and satisfaction when he discovers a Class A name. It is probable that he handles it with reverent care and with secret admiration for an individual who can work and save and then consistently give his money away to him. Picture the disdain of this crafty individual as he throws a name into the Class D list and the utter contempt with which he must regard the fellow who consistently inquires but never bites.

Improving Our News Service

WHATEVER VALUE news may have is increased by promptness in reporting it. Desirous of continuing the efficient service that by reason of its location the *Mining and Scientific Press* in the past was able to give its subscribers with respect to happenings west of the Rockies, the *Engineering and Mining Journal-Press* has arranged to receive from its correspondents by telegraph the news of important events that may occur in the Far West. Thus will be saved the time that may hitherto have been lost in mailing such reports. Western subscribers will receive a service practically as prompt as any rendered by the *Press* in the past, and those in the East will get important Western news with greater dispatch.

Use of the telegraph in reporting news events had long been the practice of the *Engineering and Mining Journal.* In a recent issue, detailed reports were published of two conventions that had taken place at Spokane and Vancouver but a short time before, something that would have been impossible had anything slower than the telegraph been depended on. Many similar instances in the last two years may be cited. For some months, moreover a cable service for foreign news has been established.

The first requisite of news is accuracy, and the next speed. In judging of the promptness of foreign mining news, however, due allowance must be made for the possible remoteness of certain districts.

Extended Use of Electric Furnaces Will Stimulate Production of Copper

THE EXTENDED USE OF ELECTRICITY as a source of heat is of interest to the great copper-mining companies, for electric equipment and transmission absorb considerable quantities of the red metal. We learn that the largest electric steel-melting furnace designed to date has been ordered by the Ford Motor Co. It will be of the Greaves-Etchells type and will be manufactured by the Electric Furnace Construction Co. The new unit will have a capacity of sixty tons of steel, and will be used in conjunction with two smaller furnaces of similar design, already in operation, and two others on order.

The Functions of Institutes—I

BY T. A. RICKARD

A RECENT bulletin of the Canadian Institute of Mining and Metallurgy contains an article on 'Institute Policy', by Mr. G. C. Mackenzie, who is secretary-treasurer of that organization. This article is prompted, it is stated frankly, by the reluctant conclusion that the Canadian Institute "has, perhaps unconsciously, been drifting for the past few years, lacking a sense of direction, and without a definite idea of voyage in the interests of the allied industries it represents and of the members of the society". Later in the same article Mr. Mackenzie says: "There is a strong under-current of feeling within the Institute that it is not functioning along the lines laid down in the charter". This is interesting because it recalls the comment frequently to be heard in regard to the policy of our own organization. The American Institute of Mining Engineers started, as its name implies, as a society of professional men; for many years it was such a professional society; then it lowered the bars and admitted almost anybody connected with mining affairs, including illiterate foremen, promoters of mining companies, agents of machinery houses—indeed almost anybody willing to pay $10 per annum. The membership became so nondescript that a group of professional men expressed their protest by starting a rival organization, the Mining and Metallurgical Society of America. This was founded in 1908 with the idea of restricting membership to mining engineers, metallurgists, and geologists of good repute. Unfortunately, the Society set forth early in its career to be exclusive rather than representative; it was un-American in spirit; its membership has continued to be so small as to render ridiculous its arrogation of a national title; today it is essentially a delightful dining club in the city of New York. However, it has done much good work in the study of current problems, such as the licensing of engineers and the revision of the mining law; it has been a *pied-à-terre* from which the Institute itself was reorganized in 1911; and it serves as a nucleus of unrest to which any dissatisfied members of the Institute can turn, for its members almost without exception are members of the Institute as well. However, the Society has not replaced the Institute; it might have done so if it had been started in a more generous spirit; it has helped to discipline the management of the Institute, but it has not succeeded in giving the mining profession the kind of national organization that either it or the Institute started to establish. The one is a mere coterie; the other is nondescript. Here I ought to say in all fairness that the members of the Society claim to avoid rivalry with the Institute, especially by excluding the discussion of technology. In the latest presidential address, that of Mr. J. E. Spurr, the idea of co-operation between the two organizations is advocated, including a joint meeting once a year. I write as a detached critic. Of late years an effort has been made to exclude undesirables from the Institute; and for a time the qualifications for election were more closely scrutinized; but the edge of reform was blunted as soon as a sustained effort was made to increase the membership, particularly in 1920. At that time a campaign of solicitation rendered futile any attempt to scrutinize closely the qualifications of candidates who had been invited to join in response to the urging of the membership committee, seconded by a president who was one of the most distinguished men of this generation. Rarely is solicitation compatible with selection. At the end of 1920 the Institute had 9323 members, whereas the Society had 302. The comparison is eloquent; obviously either the Institute is nondescript or the Society is non-representative; actually the adjectives apply, without the alternative. The Canadian Institute may have avoided both extremes, but it also has been generous in its welcome to membership, so that it includes many who are not technicians or professional mining engineers, metallurgists, or geologists. It is fair to say that to be a member of the American or the Canadian institute is no more evidence of professional standing than to be a subscriber to the 'Engineering and Mining Journal-Press'. On the other hand, membership in the Mining and Metallurgical Society does connote professional respectability. This is true also of the Institution of Mining and Metallurgy, in London, which has 1000 members, 1000 associates, and 350 students. This society, started in 1892, has aimed to make membership a voucher for good standing in the profession; and in large measure it has succeeded in doing so, because it has never engaged in a campaign of solicitation or tried to aggrandize itself by mere numbers. Like all such societies, it includes some weak sisters and even an occasional black sheep, whose weakness or blackness has developed since election to membership, but on the whole it does mean something to be a member of the Institution. The members are representative in number as well as in character. Our Institute with 10,000 members and the Mining and Metallurgical Society with 300 members are not representative, because an American mining engineering society that aimed to be representative would include about 3000 members; if it included many less it would hardly be representative; if it included many more it would hardly be selective.

The Institution in London has been well managed, thanks largely to its secretary, Mr. Charles McDermid, who has been wise both to the duties and to the limitations of his office. Another factor favorable to the success of the Institution has been the central position of London, which attracts the mining fraternity from every part of the British empire. The leading practitioners live in London, and have their offices in the City; the mining engineering profession of Great Britain is concentrated in London, and those engaged in other parts of the world gravitate to London at frequent intervals. Therefore it is easy for the Institution to maintain monthly meetings. These are well attended and are rendered pleasant by sundry social amenities. The discussions are not usually of a high technical standard, because many of the British engineers stay in London too much and are therefore out of touch with the technique of their profession, but the discussions are conducted in an agreeable manner and serve admirably to promote good-fellowship. That, after all, is one of the chief purposes of such an organization.

DISCUSSION

Heat Requirements of Chloridizing Volatilization

Bureau of Mines Official Takes Exception to Some of the Statements Made by the Late Harai R. Layng

IN THE *Mining and Scientific Press* of Feb. 25 Harai R. Layng presents the results of some calculations on the fuel consumption necessary in chloridizing volatilization as practiced in the horizontal rotating kilns tested by the Bureau of Mines and in his own proposed shaft furnace. Because of his critical comments on the work done by the Bureau of Mines investigators I feel it necessary to call attention to the premises on which Mr. Layng bases his arguments.

Several months ago Mr. Layng wrote me stating that he was carrying on some calculations on the thermal efficiency of the 20-ft. experimental kiln in our Salt Lake laboratory, using such data as he had been able to gather, asking for more, and also inquiring whether we had ever struck a heat balance on this kiln. The metallurgists at the Salt Lake laboratory asked me to tell Mr. Layng that they did not consider extensive calculations on this small kiln to be of much value. The fuel consumption was known to be high in the laboratory kiln, but tests had been made on much larger kilns, and it was felt that a better practical correction factor was available for the small-scale tests than any thermal balance.

From Mr. Layng's calculations, the Salt Lake kiln used the equivalent of about 55 gal. of fuel oil per ton of ore. This is due to the small size of the kiln and the difficulty of keeping out excess air. Instead of discussing this small kiln, permit me to present some figures from the operation of several larger kilns.

A kiln operated by the Yellow Pine Mining Co., of Goodsprings, Nev., afforded the following figures: Treating a zinc-lead-silver carbonate ore at 900 to 1,000 deg. C., in a kiln 50 ft. long and 6 ft. in diameter, set at the proper slope and rotated at the proper speed to let 35 tons of ore pass through in sixteen hours, the oil consumption was 12 gal. per ton. A Bruckner-type kiln, 16 ft. long and 4 ft. in diameter, operated by Morris Kirk in a semi-commercial plant at Harbor City, near Los Angeles, treated similar ore with a consumption of up to 16 gal. of oil per ton.

In the chloride volatilization plant of the Pope-Shenon Co., at Salmon City, Idaho, a kiln 25 ft. long by 3 ft. internal diameter treated forty tons of oxidized copper ore in twenty-four hours at a temperature of 900 deg. C. with an oil consumption of 10 gal. per ton, and when treating thirty tons in twenty-four hours, the oil consumption was 12 gal. per ton. The largest kiln yet operated is capable of treating 125 tons daily of old patio tailing at Pachuca, Mexico, and is operated by the Blaisdell Coscotitlan Syndicate. I am informed by the manager, P. A. Babb, that the kiln is 125 ft. long and 8 ft. internal diameter, heats the ore to nearly 1,000 deg. C. and uses 12 gal. of 18,500 B.t.u. oil per metric ton when treating 125 metric tons of ore daily. This is equivalent to 10.1 gal. of 20,000 B.t.u. oil per short ton.

Mr. Layng calculates that his stack furnace *should* use only the equivalent of 8 gal. of 20,000 B.t.u. oil. I am little inclined to carry on a discussion over the difference between an observed figure of 10 gal. per ton in two operations in actual practice and a calculated consumption of about 8 gal. for an untried furnace. All I wish to do is to agree that Mr. Layng's calculations for his furnace sound reasonable.

However, with these figures in mind, I wish to discount the indictment which Mr. Layng brought against the Bureau of Mines work in the following words: "The calculations that I have made, as well as other work and studies that I have done, cause me to be firmly convinced that the work on chloridizing volatilization being performed by the Bureau of Mines engineers with the experimental kiln has done and is doing more harm than good to the advancement of the art of chloridizing volatilization." I feel that the fuel consumptions obtained in actual practice of chloridizing volatilization have amply justified us in ignoring the fuel consumptions of the small kiln. The whole discussion here should merely give point to the conclusion that roasting tests in the laboratory are difficult to interpret, particularly from the standpoint of heat losses and fuel consumption.

I do not wish to condemn the work of any man as flatly as the Bureau of Mines work has been condemned by Mr. Layng, but, while we are handing around the bouquets, it might be well to say that the Bureau engineers have looked at the Layng stack furnace[1] with a great deal of honest skepticism and have read his claims for it with increasing wonder. The superintendent of the Intermountain Station at Salt Lake asks me to call attention to the fact that a false impression exists about the fuel economy of the old Stedefelt stack furnace for chloridizing roasting. Although the literature reports low percentages of coal and coke used, the ore is described as "sulphurets" and contained rather high percentages of sulphur, which served as fuel. Also, the ore was dried and heated to 200 to 300 deg. F. before it was dropped through the furnace, and the hot material had then to be piled in heaps to finish the chloridizing. Mr. Layng is the only reported witness to the efficiency of the Layng stack furnace for chloridizing *and* volatilizing, and, if I must say it, we have been so little convinced by his claims that we have never felt justified in going to the expense of checking them.

Mr. Layng also gives credit to us for "recommending" the addition of 15 per cent of limestone to certain ores to prevent sintering. I am informed by Messrs. Varley and Stevensen, authors of *Reports of Investigations*, Serial No. 2,247, that what they actually said in that paper is, "the addition of 5 to 15 per cent of lime-rock will prevent sintering in some of the worst ores."

[1] Mr. Layng described this furnace in *Engineering and Mining Journal* of Nov. 12, 1921.—EDITOR.

It will be remembered that this fact was patented by C. S. Wigton (U. S. Patent 1,264,586, April 30, 1918), the metallurgist of the Chief Consolidated Mining Co., an independent and able inventor in chloride volatilization. Messrs. Varley and Stevensen made a statement of fact, not a recommendation, but I fancy they are willing to recommend such treatment of exceedingly bad ores when it is necessary.

With regard to the questions on latent heats of vaporization, data on which Mr. Layng is unable to find, he states that the Bureau engineers informed him they had no data on the subject and he is grieved that we do not accumulate such data. He feels that we ought to specialize on the measurement of such data and leave to practicing engineers and inventors the experimental engineering work. He even intimates that we may "not realize the importance of the latent heat of evaporation," although he does acknowledge that we have devoted considerable time to determining the vapor pressures of lead chloride and silver chloride.

These accusations were unjustified. Without attempting to point out the statutory functions of the Bureau of Mines, as established by act of Congress, nor attempting to explain just how far it can go in the measurement of physical constants without getting into the fields of other departments of the Government, I wish in reply to point out the facts. Mr. Layng has in his files a letter written to him by me under date of Dec. 5, 1921, giving him the only available data we had on the heats of vaporization of several compounds. It is quite difficult to measure the heats of vaporization of these compounds in the range of temperatures involved, but it is easy to calculate them from vapor-pressure curves of the substances by using the so-called van't Hoff Isochore—not Williamson's formula. This method is thermodynamically sound and is the accepted one for calculating latent heats if no direct determinations are available. The figures which I gave him are also of interest to anyone else who wishes to make a heat balance, and I therefore give them as follows:

HEAT EQUIVALENTS, IN CALORIES PER MOLECULE

Heat of vaporization of lead chloride	40,600
Heat of sublimation of lead chloride	45,750
Heat of vaporization of sodium chloride	44,300
Heat of sublimation of sodium chloride	51,500
Heat of vaporization of potassium chloride	40,500
Heat of sublimation of potassium chloride	46,900
Heat of vaporization of sodium hydroxide	31,500

We shall soon have available for publication data on the vapor pressures of silver chloride and also of zinc chloride, and from them can be calculated the corresponding heats of vaporization and sublimation. The important metal chlorides for which we still lack data are those of copper and gold.

Without trying to check Mr. Layng's calculations in detail, the following errors have been apparent to myself and my co-workers: Mr. Layng uses 1,337.50 B.t.u. per lb. as the heat of formation of calcium carbonate and seemingly forgets that for purposes of his calculation he must subtract the heats of formation of CO_2 and CaO. The correct figure for his purpose was only 768 B.t.u. He speaks of the Williamson formula, evidently meaning that of P. B. Williamson (*Chemical and Metallurgical Engineering*, Vol. 22, pp. 1151-55, 1920), with its accompanying note and table by Wallace Savage. Most of Mr. Layng's figures on the heat of vaporization seem to be derived from this table, and, if so, he has made mistakes in calculating the heats for zinc chloride and hydrochloric acid.

What I wish to call particular attention to is the criticism of the Williamson formula made by Savage to the effect that the formula is accurate for temperatures higher than the boiling points of liquids, but it is greatly in error at lower temperatures. In chloride volatilization we are dealing mainly with the molten chlorides below their boiling points, and we depend mainly on the *evaporation* of these compounds, not on *boiling* them. Consequently, we are dealing with a range of temperatures in which Williamson's formula is not accurate, and this supplies another reason for ignoring the opportunity to check over carefully Mr. Layng's figures. In this connection, however, it is pathetic to see Mr. Layng calculate his chemical analyses to four decimal places and carry out his thermal calculations with similar thoroughness. For instance, in estimating the radiation from a 100-ton stack furnace he feels it would be "about 135.23 B.t.u. per sq.ft."

It would be interesting to know if Mr. Layng has made any analyses of his furnace gases for chlorine and hydrochloric acid, or whether his figures given in Table 3 are likewise estimates.

I have read Mr. Layng's various letters and papers on chloride volatilization with the impression that he was carrying out the very justifiable enterprise of calling attention to his own style of furnace, which he has patented, with the object of getting its advantages before the public. His repeated use of the words "my process" in various contexts makes him seem to be the inventor of everything that is good in chloride volatilization. It is perhaps well to call attention to the fact that the real inventors were probably Pohle and Croasdale, who received their first patents in 1903. The process did not flourish, for lack of a suitable fume catcher, and it was not till the Bureau took it up that the process was resurrected through our use of a Cottrell electrical precipitator on the fume. Mr. Layng has a fume catcher all his own, and whether it is any better than all the other non-electrical catchers is of little interest to us if only his furnace can live up to the claims made for it. We ourselves are not satisfied with the rotating kiln as a chloridizing volatilization furnace, but so far it has proved the best simple furnace for carrying on the operation.

I record the fact, as a matter of interest, that on the basis of the present development in the chloridizing volatilization process the Western Precipitation Co. has been organizing a separate company to exploit it, probably hoping thereby to find more customers for the use of that company's electrical precipitation process. The four present commercial installations are shut down, owing to low metal prices and the general financial troubles that afflict the mining industry, but are regarded as metallurgically successfully and will ultimately be resumed. With this in mind, I find it my duty to controvert the animadversions of Mr. Layng against the work done by the investigators of the Bureau of Mines.

OLIVER C. RALSTON.

Berkeley, Cal.

The Webster Process

I would like to offer some comments on your editorial on the Webster process of treating copper ores which appeared in the March 18 issue of *Engineering and Mining Journal*. In the first place, I do not think that it can properly be claimed that this method will preferably be adopted for the treatment of straight oxide ores of copper, as might be inferred from the editorial, except

possibly where such ores carry gold and silver, which is not usual. The problem of treatment of oxidized ores of copper—that is to say those which carry practically all their copper in acid-soluble form—it seems to me can be considered as settled. We have at least two large installations, and it seems quite reasonable to expect that improvements in details of these methods, which even now compare favorably in cost of copper produced with the costs of older established methods, will result in economies which will render predictions made at present unsafe. In my opinion, even with present leaching practice, there seems no doubt as to the relative economy of a regenerative leaching method, involving electrolysis, for straight oxide ores, except for special conditions.

As to the limitations of leaching as you state them with respect to the cost of the acid, iron, power for precipitation, and the necessary degree of crushing, I think it can be shown that the cost of power is by far the most important of these, and that acid cost need not necessarily be a factor of importance, in view of regenerative possibilities, all of which possibilities have not yet reached their full application.

Though I would not consider straight oxide ores a part of the field of the Webster method, the "mixed-ore" problem is a large one, and it is distinctly unsolved to date, although considerable sums are being spent on it by several large companies, and it is in this field that I think future application of the Webster process will lie, although in some instances possibly not a complete solution of it.

I think you are correct in saying that the process as a whole will find definite application where the cost of acid and of finely divided iron are not prohibitive, provided you make the above limitation of the statement. This, however, brings up another question—that of the necessary finely divided iron. This is the "sponge iron," on the production of which much work has been done for many years, but which is so far not a commercially obtainably commodity, although it is understood that considerable progress has been made toward its production in the Southwest.

It seems to me evident, therefore, that in any event the large development of the Webster method will have to await the evolution of the commercial production of finely divided iron at a reasonable cost.

Though not wishing to be unduly critical, I do not quite agree with you in the statement that flotation is a nominal expense. Even the flotation royalty that must be paid can hardly be called nominal, and I know of a number of large applications of flotation to copper ores where the reduction of its present cost to a nominal figure, outside of royalty, would be welcomed with some enthusiasm.

G. D. VAN ARSDALE.

Los Angeles, Cal.

Birthday Congratulations

According to the announcement in the *Journal*, this is the birthday of the *Engineering and Mining Journal-Press*, and even if it is born under such adverse signs, as stated in the last issue of the *Journal*, let us hope for the best, and I here wish it the greatest success. I have mightily enjoyed the *Journal*, not alone for the valuable information it contains, but for the vein of humor, which among the sterner realities helps to flux our troubles and afford encouragement.

Gold Hill, N. C., April 1, 1922. THOMAS SMITH.

The Westly Electric Furnace

I have read with interest the article on the "Westly Electric Furnace for Copper Smelting" in the March 4 issue of *Engineering and Mining Journal*.

I doubt if the authors take their claim for greater sulphur conservation seriously. The atmospheric oxidation of this element in standard reverberatory smelting method is almost nil, the 30 to 40 per cent elimination occurring in practice being due to sulphide-oxide reactions which take place to some extent in the electric furnace. The claim for lower loss due to a cleaner slag is certainly not supported by data in the table on page 357. In Canada or the United States the production of a slag containing 0.50 per cent copper with a 26 per cent matte would be just and sufficient cause for the dismissal of three shift bosses and, perchance, a superintendent. One quarter of 1 per cent might be allowed, in which event the electric-furnace method would have to cut the quantity of slag made in half to keep the pounds of copper lost as low as in fuel furnace operation. This would mean doubling the percentage of SiO_2 in slag. A reverberatory runs nicely on a 40 per cent SiO_2 slag, but I dislike the idea of an 80 per cent one, which might be made, but concerning which one could hardly say, "See how it runs!"

A small dust loss in reverberatory smelting, even with waste-heat boilers, is admitted. Some loss of this type would also take place in the electric furnace, even if there is a "thorough quiet settling at a perfectly controlled temperature." And is the temperature control more perfect than the oil- or coal-dust fired reverberatory? This loss in the reverberatory averages less than 2 lb. of copper per ton of charge, so even without a dust loss, and with only one-half the slag production, the estimated copper saving of 6.6 lb. is exaggerated.

That higher operating labor cost would be offset by cheaper upkeep is entirely unproved.

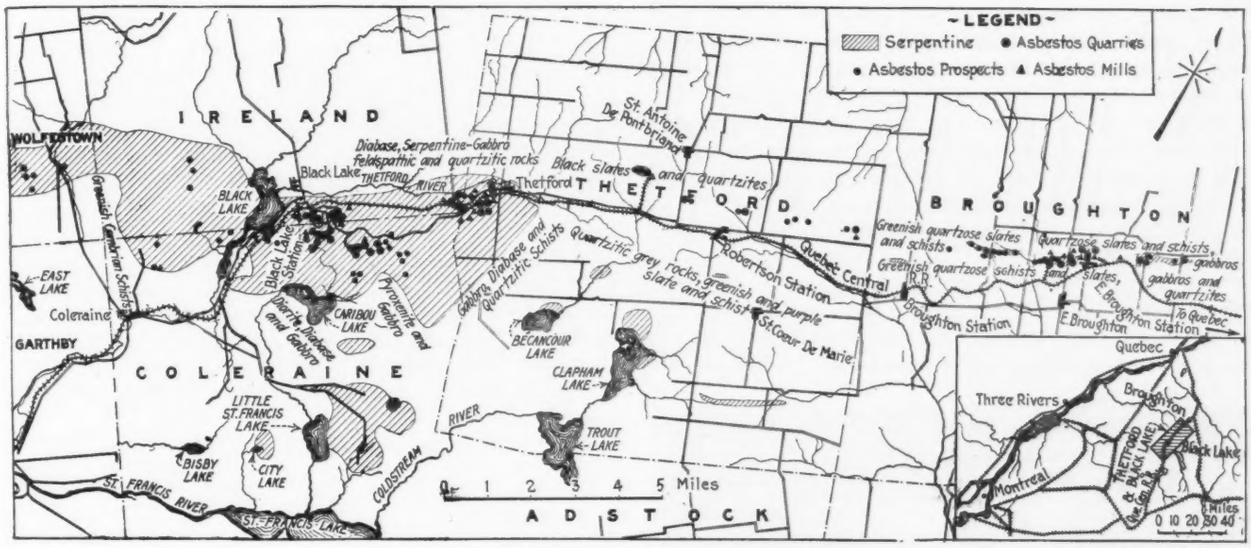
In the table on page 360 the gross fuel consumption per ton of charge appears to be given. The net—i.e., the gross minus fuel equivalent of steam generated in waste-heat boilers—would be at least 25 per cent less. For example: At Clarkdale, Ariz., 0.62 bbl. of oil is burnt per short ton of charge. (This corresponds to 4.4 bbl. per 6.5 metric tons.) In addition to carrying on the smelting, steam is generated. The production of this amount of steam would require that 0.20 bbl. of oil be burnt under power-plant boilers. In this case the net oil consumption per short ton of charge is only 0.42 bbl. (0.62 — 0.20 = 0.42), or about 0.46 bbl. per metric ton. With pulverized coal one net metric ton will smelt at least eight metric tons of charge. This would make coal at $12.40 per metric ton correspond to electrical energy at 0.2c. per kw.-hr.

The above-noted criticisms may seem like waste of time and space. For, if the comparison table be taken as correct, localities with 0.2c. per kw.-hr. energy available are as scarce as gulls following a Scotch ship. Plants where pulverized coal is delivered to furnaces at less than $10.08 per metric ton are common.

My reason for rushing into print is that the technical journals contain too many articles of this nature in which the side of fence next to authors is given several coats of paint in a thorough and painstaking manner. The other side is covered imperfectly with daubs applied in careless style. And, whether we like it or no, fences have two sides.

H. N. THOMSON.

Vancouver, B. C.



After map by Canadian Department of Mines.

Map of Quebec's asbestos region

Asbestos Mining and Milling in Quebec—I

Understanding of Local Geology an Essential Aid to Proper Working of Deposits—Open-Pit Operations the Rule—Object of Mining To Recover Largest Possible Amount of Crude Asbestos—More Efficient Methods Being Introduced

By Walter A. RuKeyser

ASBESTOS, in addition to being a non-metallic in which only a limited interest was long taken, has failed of full appreciation of its general utility and value, for want of suitable publicity, owing to the prevalent attitude of the operators themselves. This has been especially true in the important Quebec district, which has been producing from 80 to 90 per cent of the world's asbestos. In contradistinction to most mining districts of the world, there has been little exchange of information among the asbestos operators of Quebec. Flow sheets have been evolved in each individual mill; cost data and operating results have been withheld with the utmost secrecy. Admission to many mines is extremely difficult to obtain, and most mills refuse absolutely to receive visitors. Operators have in the past shown little desire to co-operate technically with one another—in fact, a spirit of jealousy has made any attempt at co-operation ineffective.

Until 1921 there existed no organization through which the mine managers and heads of departments could get together to discuss general problems, and this condition had been permitted to develop in a district representing a capital investment of well over $50,000,000, supporting a population of nearly fifteen thousand people, and with over twenty mines in operation. It is no great wonder, therefore, that the mining and engineering professions at large have little if any accurate knowledge of what has grown to be an important mining industry.

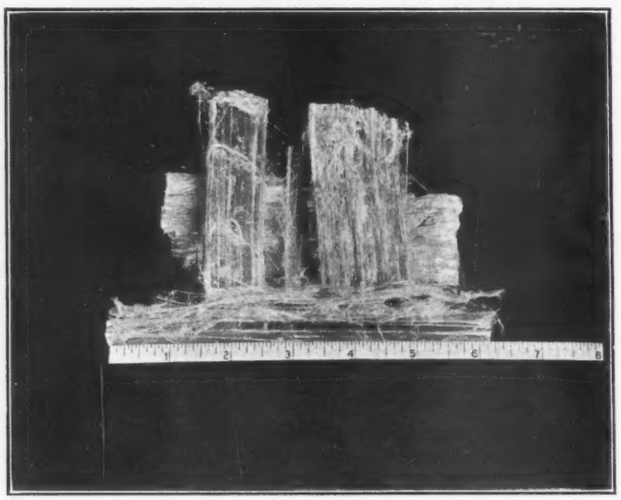
Competition Active in Asbestos Industry

There are definite and good reasons why the attitude above noted developed. The asbestos industry has been highly competitive, more so than almost any other mining business. Under the low prices prevailing up to 1916, many asbestos properties were subject to a continuous and periodic shutting down and reopening. The "marginal producer" during the periods of depression either had to perfect his mining and milling practice, reduce costs, and increase general overhead efficiency, or drop out of competition. Before the war supply exceeded demand—for the many present uses for the product had not been evolved. It therefore behooved each operator to withhold as his "stock in trade" any details of operating practice which would give him a handicap over his competitor. And that habit of business secrecy, once formed, is difficult to eliminate. Furthermore, the industry in Quebec was for the most part established, and until recently carried on, by the owners themselves. Prior to the last decade it was seldom that the operating heads of the asbestos mines were technically trained for mining asbestos, or, in fact, even skilled in other mining operations. It was natural, then, that there would not be a wide dissemination of knowledge about asbestos mining and milling or a stimulus to an interchange of ideas and technical data.

The great impetus given the industry by the war has been probably the largest single factor in effecting a change in this attitude of secrecy. During the war, demand exceeded supply for the first time since asbestos had been mined. Prices prevailed which permitted the accumulation of substantial reserve and replacement funds. The necessity of large-quantity production required thorough modernization of methods. Standardization of product became essential. This in itself implied a need of co-operation on the part of the various managements. Labor troubles, too, brought the operators together and impressed more clearly upon them the urgency of an "open shop" in technical and even business matters. Furthermore, the district has stead-

ily been attracting a class of technically trained mine operators, executives who brought with them the experience and methods of the other mining fields of the world.

This is the background of Quebec asbestos mining and shows that there have been insidious factors existing from the early days of the industry with which the present-day operators have had to cope. Such conditions as placing a waste dump on the most productive part of a property, or finding that the mill had been located without any attention to geological factors, or that large expenditures had been entailed with insufficient pay rock in sight to establish operations on any satisfactory scale, cannot in any way be attributed to the present



Courtesy Asbestos Crude & Fibre Corporation.

Chrysotile crude or cross-fiber

generation of operators in the district. As so often happens the "doctor" is called in after the mischief is done, and then there only remains to make the best of what has gone before. These facts have been mentioned in no spirit of apology for the methods used in the district today, but rather to explain that those methods have had to be evolved. The advance which has been made since the industry has been placed in a healthy condition financially, the low operating costs which prevail despite the manner in which most of the properties were originally opened up and developed—in spite of the tonnage which has already been removed—speak well for what is being done today in that district. Just how the peculiarities of the district, with its foreign language, its peculiar labor conditions, its climatic factors, affect mine operation will be brought out in the description of the problem of asbestos mining and milling which follows.

Occurrence of Asbestos Widespread

Asbestos in several different forms has been found in the following states: Arizona, California, Idaho, Maryland, Missouri, New York, Nevada, North Carolina, Oregon, South Dakota, South Carolina, Texas, Washington, Wyoming, and Vermont, and among the foreign countries reported as producing it are Australia, Brazil, British India, Cyprus, China (Mongolia and Shanghai), Cuba, Canada, France, India, Italian Alps, Japan, Korea, Newfoundland, New Zealand, Mexico, Peru, Persia, Philippine Islands, Russia, Spitzbergen, Syria, and South Africa.

Although asbestos is widespread in occurrence, a factor other than geographical position has made the Canadian deposits so pre-eminent that the large majority of the world's supply is furnished from them—the peculiar physical properties inherent to the chrysotile variety of the mineral as developed in the Quebec serpentine belt. Typical chrysotile asbestos from that district is of high tensile strength—a fundamental requisite—yet the fibers are so delicate that they can be spun into a single strand of thread which will run about 32,000 ft. to the pound, and cloth can be woven from that thread which will weigh less than eight ounces to the square yard. Canadian chrysotile has a hardness of from 3.0 to 3.5 and a specific gravity of 2.2 to 2.3. Its luster is resinous, it is translucent along thin edges, is greasy to the touch, and is white to light green in color en masse.

Chrysotile is normally prismatic, both in respect to habit and cleavage, and fibrous in structure. The separate fibers are white, lustrous, and extremely silky—"silkiness" being, next to tensile strength, an important commercial asset, permitting facile handling in the carding process which precedes the manufacture into finished rope or fabric.

In the Quebec deposits, the fiber occurs largely in commercial lengths—the "Crude No. 1" measuring from 1 in. to possibly 5 in. or 6 in.—and is of a variety of asbestos which easily resists a temperature of 2,000 to 3,000 deg. F. Temperatures as high as 5,000 deg. F. have produced no other effect than a dehydration, with attendant loss of tensile strength. Chrysotile occurs in three distinct types of deposits, cross-fiber, slip-fiber, and mass-fiber.

Cross-fiber constitutes a network of veins throughout the mass of the inclosing or parent rock, in which the growth of the crystals has been normal to the walls. This type of occurrence gives rise solely to the most valuable product, the "Crudes," and in the handling of the rock all other grades are subordinate to them. The fact that the longer fibers—milled or crude—command such a higher price than the shorter controls the entire process of mining and later extraction in milling. The deposits at Thetford Mines, Black Lake, Coleraine, and Danville are primarily of the cross-fiber type.

Slip-fiber asbestos is the type found disseminated throughout the rock mass in a form in which the fibers show a definite tendency toward orientation along an original vein direction. As the term indicates, this result has probably been produced by lateral movement or slickensiding. As applied to the Quebec deposits it is confused with the third mode of occurrence, mass fiber, but the term is so generally employed in describing these deposits that it will be used here in its more colloquial sense.

The deposits at Thetford and other Canadian places contain a considerable percentage of slip-fiber, and as one progresses northeast along the strike of the belt one sees a lessening of the proportion of cross-fiber veins, until at Robertson, five miles distant, the slip-fiber predominates. At East Broughton the deposits are practically entirely of this latter type, at least to the present depth of operations. In mass-fiber there is no definite orientation of the fibers, which are scattered irregularly throughout the parent rock.

Following is a list of the asbestiform minerals after A. L. Hall:

1. The Serpentine Group.—Hydrated magnesium silicate with a theoretical composition $2H_2O$, 3MgO, $2SiO_2$. Characterized by a high percentage of magnesia and

water. To this group belong the Quebec deposits, chrysotile, and picrolite.

2. The Rhombic Amphiboles.—Silicate of magnesia and iron with the composition $(MgFe)O_3SiO_2$. Anthophyllite.

3. The Monoclinic Amphiboles.—Tremolite, a silicate of calcium and magnesium of the composition $CaO, 3MgO, 4SiO_2$; actinolite, a silicate of magnesium, calcium and iron, with the composition $CaO,3(MgFe)O, 4SiO_2$; crocidolite, a silicate of iron and sodium, with a composition given by Dana as $NaFe(SiO_3)_2FeSiO_3$; and amosite, a new variety of asbestos identified in 1918 and named amosite from the initials of the "Asbestos Mines of South Africa," the company chiefly interested in its production. This variety is characterized by a high percentage of iron, with considerable and variable amounts of aluminum, magnesium, and calcium. Soda may or may not be present.

The following analyses bring out the chemical differences between the three main varieties of asbestos:

	Chrysotile (*a*)	Crocidolite (*b*)	Amosite (*c*)
Silica, SiO_2	40.49	51.64	50.24
Alumina, Al_2O_3	1.27	.....	.....
Ferrous oxide, FeO	.....	.....	7.80
Ferric oxide, Fe_2O_3	2.53	34.38	32.00
Magnesia, MgO	41.41	2.64	3.96
Lime, CaO	.....	0.05	Tr.
Soda, Na_2O	.....	7.11	2.12
Carbon dioxide, CO_2	.....	.....	.....
Water, H_2O (const.)	14.06	4.01 (ignition)	3.00

(*a*) Average of eleven analyses given by Cirkel.
(*b*) Dana, "System of Mineralogy," Sixth Edition.
(*c*) Best quality, white; analysis by C. Gardthausen.

The high percentage of magnesia, the practically total absence of lime, and the high water content characterize the chrysotile. As here used the generic term "asbestos" will always refer to the chrysotile variety unless otherwise noted.

Chrysotile Occurs in Two Geologic Associations

Chrysotile is found in one of two modes of occurrence. The first is illustrated by the asbestos of Arizona, Carolina, and Africa, in which the cross-fiber veins of chrysotile are associated with serpentine in limestone or dolomite. The second occurrence is in serpentine derived from peridotite or pyroxenite. This association is the more important one and characterizes the Quebec deposits.

The geology of these deposits is generally not complex, although questions of origin are considerably involved. The so-called "serpentine belt" which gives rise to the occurrences of the mineral extends in a broken outcropping from northern Vermont to the Chaudiere River in Beauce County, Quebec. Occurrences of the same rock north of the St. Lawrence River are roughly along the same line of strike and have been identified as belonging to the same intrusion.

The belt has a general trend of approximately northeast for a distance of nearly 150 miles. The main productive area centers at Thetford mines (Thetford), extending sixteen miles northeasterly to East Broughton and about forty miles southwesterly to Danville, where the productive zone of the province ends. In the Thetford-Black Lake district the serpentine has a maximum width of about 15,000 ft. (at Black Lake) and narrows down to approximately 5,000 ft. as far as is known, four miles further at Thetford. The next outcropping, three miles northeast, exposes the serpentine as a narrow, inclined-sill structure with a maximum width of about 1,000 ft. The workable belt at Robertson is between 300 and 500 ft. wide, and this width is maintained irregularly to East Broughton, ten miles distant, where the furthermost mining operations are to be found.

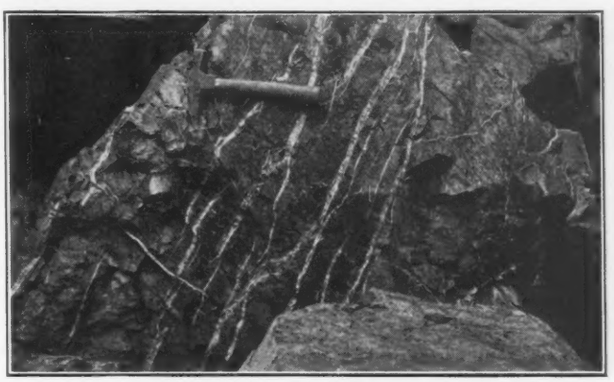
Quebec Serpentine Derived From Peridotite

The serpentine, from which the chrysotile has been derived, is a metamorphic derivative of peridotite and associated basic rocks solidifying from a molten magma probably in the form of batholithic stocks and sills. The structure of the Thetford-Black Lake district is represented by a batholith or stock, and that of the Robertson-East Broughton by sills, the initial difference in structure being responsible for the two distinct types of economic deposit which have resulted—the "Thetford Phase" and the "Broughton Phase."

The peridotite is closely associated with allied rocks, particularly pyroxenite and gabbro, into which it grades imperceptibly. Diabase is found on the outermost margins of the stocks of the Thetford phase and the uppermost portion of the sills of the Broughton. Where I have observed this rock in the field it has been a hanging-wall rock, fresh and unaltered, with sharply defined contact, and in some places capping a badly foliated and dry-appearing serpentine which carried asbestos.

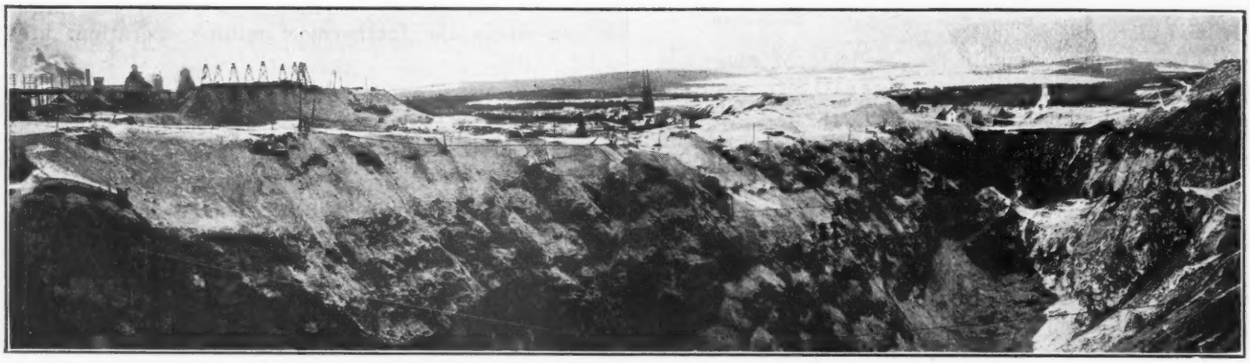
Basic Rocks Intruded by Granitic Dikes

In addition to the series of rocks from basic magmas, those of the Thetford phase are in many localities intruded by dikes and sheets of white or pinkish granite and aplite. The dikes may vary in width from mere stringers to over 60 ft., and the sheets often become batholithic in character, forming some of the main topographic features in the vicinity of Black Lake. The dip is usually nearly vertical.



Chrysotile asbestos in serpentine

Dresser believes the granite to be the most acidic but a somewhat later phase of the same intrusion, which began with the ultra-basic magmas and which became more and more acidic in character as the intrusive action neared an end. In the same way the chrome ores which are found in commercial deposits near Black Lake and Coleraine are attributed to magmatic differentiation. The chromite, like the pyroxenes, grades imperceptibly into olivine-rich peridotite, and passes from almost the pure mineral through a series of dunites into peridotite and pyroxenite free from any chromite whatsoever. The granite, however, forms sharp contacts with the peridotite, and occurs always, as far as I have observed, in well-defined structures, with attendant contact phenomena. In fact, most of the rare minerals which have been identified in the locality, such as colerainite, for example, seem to owe their origin to contact metamorphism by the granite or aplite.



An open-pit operation at Thetford in winter

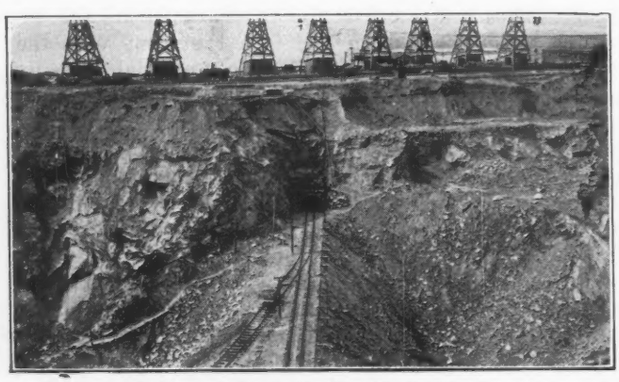
Dresser, in his classical "Memoir No. 22" of the Canadian Geological Survey, on page 27, compares the igneous rocks of the two phases as follows:

Thetford Phase	Broughton Phase
Peridotite partly altered to serpentine	Soapstone Serpentine
Pyroxenite	
Gabbro	Greenstone schists
Porphyrite Granite Aplite	(Lacking)

I have pointed out that the deposits of asbestos in the Province of Quebec fundamentally owe their origin to a series of basic igneous rocks which were forced up from great but unknown depths. These igneous masses broke through a series of stratified rocks, generally conceded to be of Cambrian age, consisting of slates, quartzites, and sandstones, which in their present condition are typical products of regional metamorphism.

The Cambrian is overlain on the southeast by altered black slates of Ordovician age. On the northwest, or underlying side, the gray slates and quartzites are succeeded by quartzose and sericitic schists. In the accompanying map the area representing rocks of sedimentary origin is shown as undifferentiated Paleozoic.

After the intrusion of the Thetford series in post-Devonian times, the entire district was further subjected to a series of uplifts and depressions accompanied by lateral pressure. The stratified rocks, as already pointed out, were greatly deformed and altered into their respective metamorphic derivatives. The fact that the serpentine *and asbestos* of the Broughton phase have been subjected to regional compression, as shown by the extreme foliation of the rock at Broughton, leads me to believe that the rocks of both the Broughton and the Thetford series were subjected to such regional stress at a much later date than that of the intrusion. The larger masses of the stocks and batholiths at Thetford by their very form were better able to withstand compression than the thin sills characterizing the Broughton phase. Thus, the original form of the intrusion played an important part, determining in what form the asbestos eventually occurred. As further evidence of this theory we find the sill at Broughton to have an interstratified appearance with the metamorphic derivatives of the sedimentary formations. It dips with them approximately 65 deg. to the southeast.



An open-pit mine at Black Lake

Alteration to Serpentine a Deep-Seated Process

Serpentinization may well be a deep-seated process, evidenced by the fact that the parent rock is of plutonic origin, as well as the granite which in turn intruded the massive basic series. The alteration to serpentine consists simply in a hydration of the peridotite. It is more logical to believe that this hydration has been accomplished by siliceous magmatic waters rather than that it was produced by meteoric (descending) ones.

Alteration by siliceous magmatic waters is expressed possibly by the equation:

Olivine Serpentine

$$3Mg_2SiO_4 + 4H_2O + SiO_2 = 2H_4Mg_3Si_2O_9;$$

whereas a possible alteration by descending solutions carrying water and carbonic acid might be represented by the following:

$$2Mg_2SiO_4 + 2H_2O + CO_2 = H_4Mg_3Si_2O_9 + MgCO_3.$$

However, in the field or under the microscope, I cannot remember seeing any evidence of the presence of magnesite ($MgCO_3$) associated with the resultant serpentine. In which event one would further suspect the origin of the circulating waters to be magmatic.

Constant Proportion of Asbestos to Serpentine

It is interesting to note that the olivine of peridotite gives rise to serpentine, the pyroxene of the pyroxenite being altered to soapstone. Under the microscope the serpentine in thin sections reveals a fibrous structure, although without orientation. Serpentinization occurs along narrow bands in the peridotite, at the center of which may or may not be included veins of asbestos. If present, these veins of asbestos always seem to bear a constant relation of approximately one-sixth of the width of the serpentine band. The band of pure serpentine is always an invariable accompaniment to the veins of asbestos.

The two outstanding problems in the genesis of as-

bestos are the source of the vein material and whether the veins are the result of the filling of open fissures in the rock mass or a crystallographic outgrowth beginning with minute cracks.

Source of Vein Material Generally Conceded To Be From the Serpentine

The consensus of opinion at the present time is that chrysotile has been derived by a solution and subsequent crystallization of the more or less amorphous serpentine. The serpentine is thus the source of the asbestos, and there has been little if any migration of the solutions. The theory becomes well supported when one considers the microscopic evidence of serpentine having a fibrous although unoriented structure, as well as that the chemical composition of both serpentine and chrysotile is practically the same. This is brought out in a comparison of the following analyses, taken from page 60 of Dresser's "Memoir No. 22":

	Peridotite	Serpentine	Asbestos
SiO_2	38.16	40.08	39.62
TiO_2	None	None	.....
Al_2O_3	0.63	2.11	0.81
Fe_2O_3	3.32	1.13	4.52
FeO	4.76	1.70	1.90
MgO	41.84	37.90 (*a*)	39.73
CaO	0.68	0.20	Trace
K_2O	0.20	0.10	Not determined
H_2O (—110°)	0.47	1.35	0.43
H_2O (+110°)	9.63	13.89	13.32
	99.69	98.46	100.33

(*a*) Probably low.

Field evidence usually shows the increased presence of the mineral—i.e., the richest ground—near the granite dikes. I consider this due not necessarily to the action of the magmatic waters, which would have had undoubtedly a chemical reaction on the material, but to the fact that these intrusions would create a great increase in the number of cracks and potential fissures. The loci for the later vein formation would naturally result from shrinkage of the rock mass due to dehydration during contact metamorphism. There would also be a shattering action on the rock by the stresses set up upon the intrusion of the granite.

One more fact substantiates the theory of the formation of the veins of asbestos in place. I have frequently seen in the granite masses of the Black Lake-Thetford district, and in the siliceous rocks of the hanging-wall contact in the Broughton district, veins of quartz having the appearance of pseudomorphs after asbestos—i.e., having a crystalline structure elongated at right angles to the vein direction, with the typical asbestos "bundle" appearance, without, of course, the true fibrous structure.

Original Fractures Cracks and Not Open Fissures

The conclusion from all the evidence is that the veins are portions of serpentinized bands which have crystallized in place, a view by no means original and expressed by Dresser, Diller, and others.

Most students of the origin of asbestos hold to the belief that the great number, the size, and the position of chrysotile veins in the ground, which may run as high as 10 per cent in mineral, make it improbable that the spaces now occupied by the asbestos were once open fissures. It is pointed out that as the serpentinization was probably a deep-seated process at such depths as were involved it would not be mechanically possible for 10 per cent of the total rock mass to exist as open fissures, some of which are 100 ft. long and an inch or two wide.

Ox-team haulage still used in district

The following suggestions have been made as to the origin of the cracks or fractures: (1) That they were contraction joints resulting from the cooling of the peridotite from the molten magma. (2) That they resulted from fissuring of the rock mass under the stresses set up by the increase of volume during serpentinization—a process of hydration. (3) That they are the results of fracturing upon the intrusion of the granitic masses, both by actual compression and by contact metamorphism (dehydration). (4) That they were created by straight regional metamorphism. (5) That the fractures were caused by exfoliation of concentric shells from angular blocks already formed by the other factors.

The general conclusion is that the veins did not exist originally as open fissures but rather as potential fissures, partings in the rocks, cracks, or fractures which acted as channels for the permeating waters, the asbestos being crystallized from the solution of the serpentine.

Slip-Fiber Asbestos Shows Evidence of Subsequent Shear Action

The slip- (or rather mass-) fiber asbestos of the sills at Broughton occurs always in those parts of the structure which have been most sheared and shattered. This may be due to the fact that the shearing action has evidently accentuated the microscopically fibrous nature of the serpentine and has permitted facile permeation of the entire rock mass by circulating waters. The parallel arrangement of the asbestos suggests that it was formed after the shearing action had ceased. In passing, I consider the asbestos of the Broughton phase to be of two distinct ages, evidenced (1) by the veins of cross-fiber which exist and which appear sheared by a later movement of the rock mass, and (2) by the slip- or mass-fiber which it is clear was formed at the same time or subsequent to the shearing movement.

Mode of Origin Indicates Asbestos Continues With Depth

The fact that the original peridotite is a plutonic rock and that the serpentinization, the fracturing, and the action of magmatic waters are also deep-seated processes leads to the conclusion that the asbestos deposits may extend to depths below those of economic mining. The deepest actual development work in the Quebec district extends well over 500 ft. below the surface, without noticeable change in the quality or quantity of the asbestos. Recent diamond drilling has proved reserves to continue with depth for all purposes of practicable mining for a generation to come.

The second practical deduction refers to the quicker

rate of erosion of the softer and asbestos-bearing rock. The richer ground may therefore be found at lower elevations than the harder and more barren—and at the same time the tendency would be for the good areas to be covered with glacial drift rather than by a capping of rock.

In late geological times the district was subjected to a major glaciation which advanced from the north-northwest and which peneplained the region. In the retreat of these ice sheets as well as that of the local glaciers the deposits were for the most part covered

An outcrop of a crude asbestos vein

over by drift. This drift forms the overburden, which must be removed before open-pit operations are attempted, and comprises one of the chief overhead and development charges in modern asbestos mining.

The present methods of mining the Quebec deposits have sprung from, and of necessity been evolved from, the former operations dating back to the initial exploitation of the district. The past methods were directly influenced by the geology of the deposits and a lack of capital in the hands of small individual owners. The modern tendency has necessarily been based to a far greater degree on considerations of climate, size of holdings, type of labor, and several other technical factors.

First Commercial Production in 1862

The history of the district dates back to 1862, at which time the first commercial exploitation of asbestos was attempted on a large scale by an English company. Cirkel reports that at this time the first asbestos in the Province of Quebec was discovered near the village of St. Joseph, on the River Plante. This occurrence is a few miles beyond East Broughton, the end of the commercially important deposits; and though the fiber was of good quality, the quantity was not sufficient to constitute a commercial deposit. In 1877, however, asbestos was discovered near Thetford. Some stories relate that it was actually the cutting of the right of way of the Quebec Central Ry. which resulted in the uncovering of the deposits. It is certain that the railway, being so located as practically to follow the serpentine belt throughout its strike, was the greatest factor in the immediate development which followed, aided by the outcropping of the deposits or to their being only slightly covered with glacial drift. Furthermore, the district was ravished by forest fires, which greatly aided in the uncovering of the deposits.

Operations Carried on Only for the "Crude"

The first mining operations were begun in 1878. At that time their object was merely to get into the richest fiber-bearing rock as quickly and cheaply as possible. Owing to the geology of the deposits, the method adopted was feasible and practicable. The owners of the land were generally the operators. At that time only the crude fiber had any value; milled fiber was unthought of. Thus, the best, the longest, silkiest asbestos was cobbed out; and what would today constitute a high grade of mill rock was thrown out on the dump with whatever waste accumulated during the operations. The dumps were often placed without any thought for the future, regardless of the geology of the deposits, and without consideration of the fact that the industry might some day develop to such an extent as to necessitate an entirely different method of exploitation.

For the next twelve years or more the district developed rapidly. Villages sprang up in the neighborhood of the mines, the properties were exploited on an ever-increasing scale, prospecting was conducted actively and large capital was attracted to the industry. Thus, in 1885 seven mines were reported as producing an annual total of about 1,400 tons of asbestos—naturally all crude, the cream of the deposit. The industry then employed 350 men, and the total value of the product could not have far exceeded $75,000. At that time, the "first quality" brought $80 per ton at the mine; the "second quality," $60; the third, $40, and the poorest, $10. During the peak prices of early 1920, the top quality, No. 1 Crude, brought from $2,000 to as high as $3,000 per ton, and the "sands," which are practically barren of fiber, brought as high as $15 per ton.

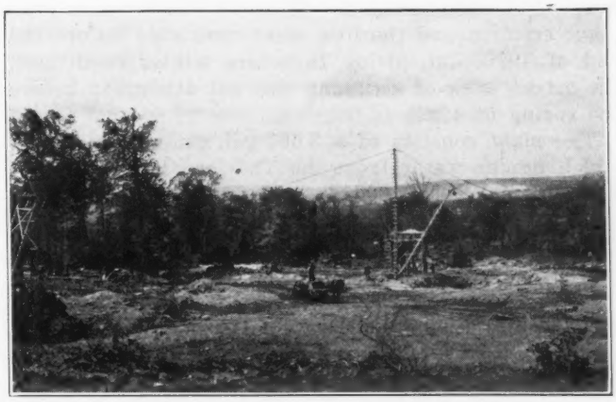
From 1885 there had been a slow but steady increase in the value of the product, until in 1900 the best quality crude brought $300 per ton. This so stimulated production that an oversupply resulted, and a diminution in prices followed during the succeeding years. Thus, at the beginning of the war, No. 1 crude was bringing about $200 a ton. All but the mines producing the best quality of asbestos had been forced to close

down; and many properties either changed hands, were forced to reorganize, or, to effect more economical operation, were consolidated under one management. Furthermore, owing to the increased prices of the better grades, the manufacturers of asbestos had been experimenting to develop a process for utilizing the shorter fibers. Many new uses for these shorter grades were found. All this created a demand for what is now known as the "milled fibers," the products of mechanical concentration. Mechanical milling methods were first attempted on an experimental scale, about 1890, and twenty years later fifteen mines in the district were sending material to about nineteen mills, with a combined total daily capacity of 8,520 tons, according to Cirkel. The combined output of these mills and mines in 1909 was:

	Tons	Value
Crude	3,074	$575,510
Fiber	14,776	1,709,077
Fiber No. 2	45,499	

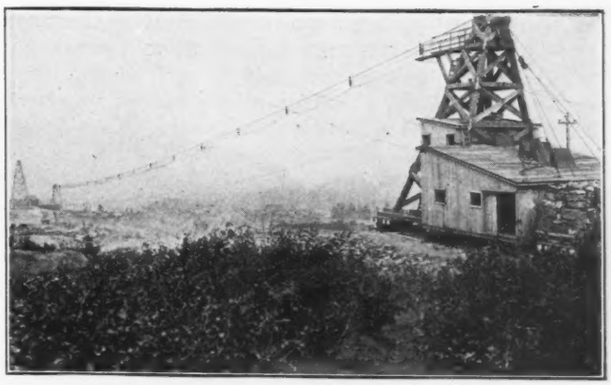
The average price of the crude was $187.22 per ton and for the fiber, $28.35 per ton. The year 1920 found asbestos at the height of its demand and the peak of its market value.

Because of lack of capital and the fact that the asbestos-bearing deposits outcropped, the early operators found it feasible and economical to exploit them by means of small open pits. The pit was usually started by means of a swinging-boom derrick, using boxes which held perhaps a ton. The rock was drilled either by hand or by heavy, steam-driven, tripod, piston drills. At the beginning the plant of an asbestos operator consisted primarily of one or more derricks, a hoist, and possibly a piston drill and a boiler. The mine would be worked only for the crude, milling not then being commercially practicable.



Prospecting with open pits and shaft

When the pits became 30 or 40 ft. deep, the derricks were supplanted by a cableway or by two or more cableways. These were of the most primitive type and had a capacity of about 100 tons per ten hours. This method of operation has persisted in principle to the present. Even in respect to detail there has not been evolved a marked change in method. However, during the last three to five years the industry has found itself at the beginning of a new era, which demands output on a much larger scale, with costs kept at a minimum. This is largely due to the unrivaled demand, the accumulation of reserve funds which permitted of costly experimentation, and the attainment of depths in some pits no longer safe nor economical for open-pit mining (especially true of those mines whose property was hemmed in by others); and in addition the mills had so increased in capacity that the problem of room for the waste dumps had become a serious one. Mines which had been "high-graded" of the best crude had to be "trimmed-up" so as to permit further working. The district was beginning to attract a type of technically trained operator, and finally, with the already advanced stage of development of the open pits, the severe Canadian winters were more and more interfering with efficiency and continuity of operation. As a result of such considerations there is today a distinct trend toward the application of combined or underground metal-mining methods, and the most recent development has been with that end in view. The Thetford mine of Consolidated Asbestos, Ltd., is thus producing its entire output from such workings. Even in stripping the overburden, it has now become necessary to employ, in Thetford at least, mechanical or semi-mechanical methods. The immediate future demands that ground covered by the deepest drift be no longer neglected.

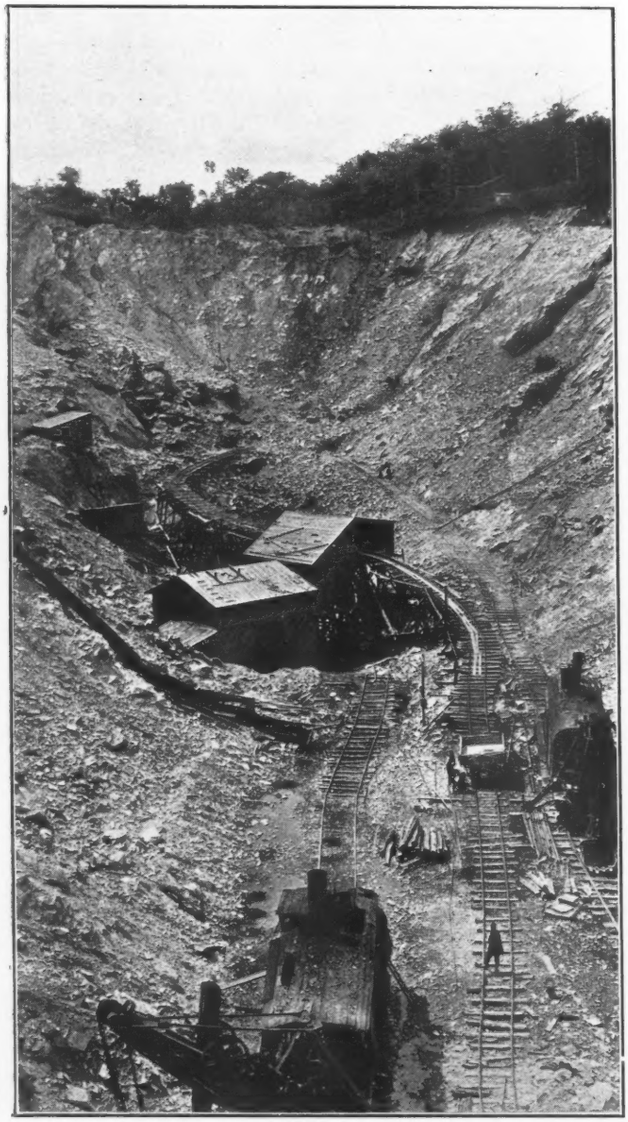


Cableway for working asbestos open pit

The methods used in stripping the overburden preparatory to open-pit mining vary from the most primitive, involving hand labor and slow transportation, to those processes that are dependent upon a minimum of the human element. The overburden consists of unconsolidated clays, sands, and gravels containing glacial boulders of all sizes. There is considerable vegetation. The drift varies in depth from little or no covering to as much as 60 ft. Where excessive, it is most amenable to the application of underground mining.

The choice of stripping method depends, of course, upon the depth of overburden, facilities for handling and disposing of the cover, and a balance between initial

Calyx drill used in prospecting



Steam shovels used in mining slip-fiber asbestos. Note primary crusher house in pit

outlay and operating charges. At many of the mines—and this is especially true of the Broughton deposits, where the drift averages but 5 to 10 ft. thick—a high initial investment is not warranted, and hand methods are nearly always used. The work is usually contracted on a cubic yardage basis, the rate varying from 60 to 90c. per cu.yd., depending upon the nature of the drift. Light cars on portable track are being used to an increasing degree, instead of the dump carts formerly employed to move material, but it is extremely difficult to get the class of labor which is available to adopt any method to which the men are not accustomed. Scrapers and drag-line excavators have also been tried out, but with no great success, as many boulders have to be handled. Where the stripping to be done is of larger lateral extent, and there is enough yardage to justify the first cost and upkeep, light cableways are used. This method has been particularly successful if there is enough material within the length of the span and within the reaching distance of each set-up of the cableway to justify the installation. With this method the cost can be reduced to as low as 30c. per cu.yd. with each cableway handling about 200 cu.yd. per shift. The boxes commonly used hold about 1 cu.yd. The earth is loaded by hand or by steam shovel.

Where the overburden assumes a thickness of 15 ft. over a sufficiently large area, steam shovels are used in conjunction with side-dump cars of the Western type, the cars being hauled by contractors' locomotives. Until recently this was the method generally employed at Thetford, at the Bell mine of the Keasbey-Mattison Co., the Bennett-Martin mine, and the Beaver and King mines of the Asbestos Corporation of Canada. Although the railroad type of shovel is used to some extent the smaller, more flexible caterpillar or tractor type has found wider application. This last noted machine has a 1- to 1½-cu.yd. dipper and handles from 300 to 500 cu.yd. per shift.

Hydraulic Stripping Latest Method Adopted

The Asbestos Corporation of Canada decided in 1920 to strip a large area at its King mine, at Thetford, where the drift reaches a thickness of over 60 ft., an area approximately 1,300 ft. by 1,000 ft. requiring stripping down to the solid serpentine—a volume of about 600,000 cu.yd. being involved. Bids were asked for from several contractors, the choice of method being left to the bidder. The Fraser-Brace Co. was awarded the contract, and that company decided to adopt hydraulic methods. Most of the preparations, plant erection and the like, were completed before the end of 1920, but, owing to severe winter conditions, the actual work of stripping was not attempted before the spring of 1921.

The plant consists of a 3,500-gal. centrifugal pump, which pumps water from the Thetford River through a 20-in. pipe line 3,000 ft. long. This water is discharged through giant nozzles, the run-off flowing to a specially prepared sump. From this the disintegrated overburden is pumped out by means of a 6,000-gal. pump through a pipe line 4,000 ft. in length to a point beyond the Thetford River at the end of the dumping grounds of the company. Wooden pipes, reinforced by iron hoops, are used for both the clear water and the mud.

I am told that difficulty has been experienced in the use of the method described, owing to the extremely clayey nature of the material to be handled. Furthermore, the frequent occurrence of boulders, some of which weigh many tons, necessitates a great deal of supplementary work, and, finally, the work must be suspended in winter.

By any one or a combination of the above-noted systems the overburden is removed from the deposits which are to be worked by open methods. The stripping is carried on sufficiently ahead of mining operations to prevent admixture of the soil with the mill feed. Under conditions where the cover becomes excessive, or where the dumping facilities are limited, underground methods have been adopted. Thus, in the operation of the Thetford mine of Consolidated Asbestos, Ltd., I believe this to have been a contributing factor in the decision to change from the open-pit mining to underground.

With a depth of cover of 20 ft. the charge per ton of mineral developed is approximately 4c., with the average depth of the pit 150 ft.

Mining Differs in Thetford and Broughton Types

Present-day operations differ essentially in the cross-fiber and the slip-fiber deposits. Wherever cross-fiber —or, to be more exact, crude—is to be mined, the controlling factor of the method adopted is that the entire

mass of broken rock must be fine-combed for the crude before being sent to the mill. The slip-fiber deposits, on the other hand, do not necessitate such handling, for the fiber is disseminated throughout the entire rock mass, and practically the entire output of the mine goes to the mill.

By "Crude No. 1" is meant all hand-cobbed veins of unbroken fiber-length of 1 in. or over. This is sold on color and length, the Thetford product being extremely silky, white, and of great tensile strength. The Black Lake crude is darker in color, slightly harsher than the Thetford, but of similar tensile strength. No. 2 crude averages $\frac{5}{8}$ in. and refers to material recovered from veins between $\frac{1}{2}$ in. and 1 in. long. "Run-of-mine" crude refers to a product in which the lengths have not been carefully sorted, and may contain material as short as $\frac{1}{4}$ in.

For every thousand tons of rock mined approximately one ton of crude is cobbed out. But when one considers that at peak prices No. 1 crude brought from $2,500 to $3,000 per ton, against $500 to $800 for the best grade of milled fiber, and an average of not over $100 per ton for the latter, it is easy to understand why so much stress is placed upon the recovery of the crudes, whatever process of working is adopted. This, then, is the reason why so much hand labor is used in the Quebec asbestos industry and why the methods of mining appear inefficiently planned to one not familiar with the problem.

The methods by which asbostos is now mined in Quebec may be broadly classified as follows:

1. Open pits.
2. "Glory holes" and shrinkage stopes.
3. Combined open and underground workings.

In open-pit operations involving the handling of crude, the cableway has survived throughout the life of the industry, and this method is still responsible for the greater proportion of the rock hoisted. All of the rock mined in slip-fiber deposits comes from open pits, but the steam-shovel method has partly supplanted the cableway. Where the pits have become too deep for safe and economical operation, where property holdings are too restricted to allow of suitable expansion, or where the overburden cannot be economically removed, the open pit has been developed so that the rock is milled down to a lower level and hoisted through a shaft. A typical shrinkage stoping system has been developed at the Quebec Asbestos Corporation mine. This method permits of a large wet-rock storage in the stopes and more flexibility in operating during the severe Canadian winters. Wet-rock storage on the surface is restricted in winter because of excessive freezing.

The "combined" methods, a designation that I have used for those in which the topography permits of development by means of a tunnel or adit driven at an elevation above that of the mill bins, are especially applicable to the nature of the ground at Black Lake.

The pit is generally carried in benches varying from 20 to as much as 75 ft. in height, with a usual average of 40 ft. In drilling, preparatory to blasting, the modern tendency has been distinctly in favor of the lighter hammer drills, although the slow piston drill, both steam and air driven, is still used. Holes were formerly drilled to 12 or 16 ft. in depth, but experience has proved the efficacy of the deep hole. For this purpose, the Ingersoll-Rand "88," the I-R "submarine," the Denver Rock Drill Manufacturing Co.'s "turbo-rotator," and similar drills have found excellent application—drilling holes 2 in. in diameter as deep as 40 ft. In an unusually interesting operation, a Sullivan submarine drill is used at the Quebec Asbestos Corporation's mine at East Broughton, drilling a 3-in. hole to a depth of 75 ft.

The drill holes are generally put down nearly vertically in a series 15 to 30 ft. from the face, and are spaced 10 or 12 ft. apart. "Lifters" are then put in at a slight angle to the horizontal. They are charged heavily, usually with 40 per cent gelatine dynamite, but under difficult conditions, where granite is encountered, as high as 60 per cent is used. Ammonia powder also finds considerable favor both in Thetford and at Broughton. Series firing by battery is almost universal. Block-holing is done by various drills of the jackhammer type by some operators in the district, though often "mud-capping" is practiced.

Churn drilling has not been found economical, owing to the fact that the subsequent operations are not on a sufficiently large scale to warrant the installation of machinery capable of handling the resulting blasted rock without considerable rebreaking. This is especially true at East Broughton, where the mills are capable of handling only up to 1,000 tons per day and the steam shovels of the caterpillar type have comparatively small buckets.

To be concluded

Small Canadian Platinum Production

Previous to 1919 no attempt was made in Canada to recover metals of the platinum group, according to the Canadian Department of Mines. The principal source of these metals is believed to be the nickel-copper ores from the Sudbury district, the matte from which was previously exported for refining either in the United States or Wales. Both the International Nickel Co. and the Mond Nickel Co. still export their product in the form of residues or nickel-copper matte containing precious metals. These latter are recovered at the refineries in New Jersey and Wales, respectively.

No data regarding recovery of platinum metals at Swansea have recently been made available, and as a consequence it has been somewhat difficult to determine the quantity of platinum contained in ores produced in 1921. The British America Nickel Corporation, which began operating its refinery at Deschenes, Quebec, early in 1920, but which was closed down early in 1921, will be in a position to recover platinum and related metals when operations are resumed. A few ounces of native platinum are won every year from the alluvial sands in the Tulameen district of British Columbia, but to date no large-scale working of these deposits has been attempted.

Taking no account of the platinum contents of the Mond matte which was exported to Wales, regarding the platinum contents of which no data were available, the platinum production from Canadian ores in 1921 amounted to 269 oz. Other associated metals were palladium, 591 oz.; iridium, rhodium, ruthenium, and osmium, 56 oz. Only 8 oz. was reported as recovered during the year from the alluvials of British Columbia. The Ontario output was produced in part by the Deschenes plant refining Sudbury matte, and was partly recovered in New Jersey by the International Nickel Co., treating residues from the Port Colborne refineries.

The Trade Association*

Rapid Development of This Type of Organization Stimulated by War and Post-War Industrial Activity—Large and Useful Field Open to Them—Secretary Hoover Sees Opportunity for Their Employment To Help Stabilize Business

BY FELIX EDGAR WORMSER
Assistant Editor, *Engineering and Mining Journal-Press*

MINING ENGINEERS are perhaps most familiar with the trade associations through the activity of these organizations in their own industry, although the notoriety which the disclosures of the Lockwood Committee, investigating the housing shortage in New York City, have heaped upon some of them in the building trades may have helped to make the name more popular—and unpopular. The American Iron and Steel Institute, the American Petroleum Institute, the American Zinc Institute, the National Coal Association, the Copper and Brass Research Association, and the Talc and Soapstone Producers' Association are a few examples of the organizations covering the various branches of the mining industry, and although they are of comparatively recent growth, the trade association is by no means a new development. The old English guilds may be considered direct ancestors of the present bodies. However, it is only during the last ten years, a period for the most part of intense commercial activity, that the trade associations have multiplied like rabbits. Well over 1,000 of them are known in the United States alone, and they cover almost every industry from the manufacture of noodles to zinc. The zenith has been reached in an association of such associations.

The trade association is organized for the mutual benefit of the companies or individuals engaged in a particular kind of business—competitors, in other words. It should not be confused with commercial associations, chambers of commerce scattered over the country, whose membership is made up of manufacturers of a *variety* of products. Naturally, trade associations must have a definite objective to justify their expense of maintenance, but the sphere of activity has not been any too strictly defined, although the courts have occasionally rendered decisions affecting their legal boundary of action. In general, they are formed to tackle problems of common concern, perhaps the tariff, or fostering the consumption of the article produced and manufactured by an industry, or some kindred problem. Of the many important activities in which they may interest themselves a few are: To promote a friendly feeling among members, to discourage unfair competition, to encourage high standards in the industry, to improve commerce and trade, to establish a code of ethics for the guidance of members, to compile statistics of the industry, and to watch legislation affecting the industry. Each trade association usually has definite ideals which are carefully set forth in its articles of incorporation.

The trade association has a great opportunity for constructive work and is here to stay. Several trade associations have overstepped the bounds of legality in their actions, not without severe censure, and have unfortunately showered uncalled-for criticism upon the shoulders of the law-abiding ones. The respectable associations are so much stronger that intelligent publicity, which they are only now beginning to receive, should soon eliminate any bad impression that may have been created by others. In those circumstances in which trade associations have been prosecuted, collusion has generally been shown to exist between members to maintain high prices and restrict competition. They have thus followed in the footsteps of the old guilds in endeavoring to bring about set prices through the use of force. So many other activities are distinctly within the range of activity of the trade association that it is a pity that some have taken the line of least resistance and brought unwarranted opprobrium upon others.

THE FIELDS OF ACTIVITY

At present there is clearly a field in which the trade association may gambol to its heart's content, another one in which it may not trespass, and a contact zone containing an indistinct dividing line. Any step taken collectively which is intended to restrain competition may subject the association to criminal action. Trouble has arisen in dealing with prices—a subject that is still in a twilight zone, but which the courts are helping to define so that these organizations should soon know exactly what information they are permitted by law to collect and distribute and that which is forbidden.

A few groups have gone so far as to collect and disseminate the daily prices at which members' business has been transacted, maintaining what they termed an "open competitive price" plan, but which was neither open nor competitive. This scheme contemplated the daily collection from each member of information regarding bids made in competition, prices received for the product sold, together with data covering production and stocks. All this information was collected by a central agency and distributed to the individual members of the trade association. The plan was openly competitive only as far as the producer was concerned, for the information was not available to both buyer and seller alike. Much harm has been done by the use of this misleading designation. Most of the bodies adopting this practice have got into serious trouble. The exchange of price information among members places a weapon in their hands which can readily be used for abuse in restraining production, raising prices, and for other objectionable activities. Secretary Hoover, who is rendering inestimably valuable service to the honest trade association, has intimated that publication of the statistical records of these bodies, whether past prices, stocks, or production, will place both consumer and producer on the same footing, enabling them to plan operations according to market indications and discouraging one from taking undue advantage of the other.

PUBLICITY THE GREATEST STUMBLING BLOCK

Much persuasion will no doubt be required to induce trade associations to make their statistical compilations public. Some of them have already wholeheartedly turned their records over to the Department of Commerce, which has used them in its new monthly publica-

*The first of a series of articles on the trade association movement. The second will deal with the work of the trade associations in the mining industries.

tion, *Current Survey of Business*. The American Zinc Institute is issuing valuable figures every month to the Government and the public.

Some groups are fearful of the result of publishing their statistical records. Their attitude is well illustrated by the remarks a metal producer made to me recently, who maintained that the former publication of certain metal statistics covering production, consumption, and stocks worked satisfactorily while the statistical position was good, but that as soon as stocks began to accumulate consumers became unduly influenced by the reports. Hence the service was abandoned.

The fear that the consumer will profit to a greater or even an equal extent by the publication of trade statistics doubtless restrains some associations from making their compilations generally known. Education is needed to convince many that group publicity is for their best interests. Trade associations covering the raw materials will profit by the information gathered by manufacturers' associations using the raw materials, and vice versa. It is difficult to see how Mr. Hoover's admirable object of achieving stability in production and distribution can be attained unless both producers and consumers are advised of the actual market conditions, so that they may act intelligently and not upon hearsay and rumor.

The intensity of world competition makes it absolutely imperative that American business men should exert every effort to improve their costs of production. Not an unimportant byproduct of the successful use of the trade association will be easier competition with foreign trade, the elimination of waste in industry, and the lowering of the cost of living, objects which Mr. Hoover has in mind in endeavoring to bring about a broader development of the trade association. If these are not desirable ends there is little use in bothering with the organizations.

Wide Field Open to the Trade Association

The industries which have been the most competitive are the ones which have been the quickest to see the advantages of the trade association. They have turned to it rather than to the other alternative, consolidation or amalgamation of the various units of the industry. After becoming federated in a trade association each member can co-operate with his fellows in establishing relations whereby the many problems which face the industry may be collectively attacked.

The collection of statistical information is only one of the important functions of a trade association. The other activities have doubtless been obscured by the notoriety achieved by unscrupulous societies tampering with prices and competition. Standardization offers great possibilities, to mention but one field. The unnecessary variety of products produced by some industries and the complete lack of a uniform standard in others—witness some of the non-metallics—are fertile fields. If intelligently directed there should be no harmful effect because of over-standardization, stifling of originality and initiative. The work of the National Paving Brick Manufacturers, upon which editorial comment in *Engineering and Mining Journal* was made several months ago, was surely worth while. In but a short session the number of different sizes of paving brick was reduced from sixty-six to seven.

Disregarding for the present the collection of statistical information concerning prices and costs, the trade association is fitted to collect promptly and efficiently other data of great practical value to industry—information regarding production, consumption, and stocks. Frequently, trade associations have felt that the consumer receives an advantage for which he does not pay if these figures are made public, leaving out of consideration the advantage derived by companies not affiliated with the trade association but in the same business. Publicity in statistical compilations will do more to give the trade association a good name in the public mind than any other step. The definite trend is in that direction, which is due largely to Mr. Hoover's efforts and the work of the judiciary.

Competitors Given Equal Opportunities

Were a trade association to do away with competition no fate would be too hard for it. On the contrary, it promotes rather than restrains trade; it gives competition intelligent direction and can help eliminate great waste in industry. One of the great advantages possessed by a large industrial organization is its ability to profit by information which it is in a superior position to acquire with the aid of a well-spread-out business. Trade associations, in distributing information to members regardless of size or importance, place them all on the same footing and eliminate a tendency to consolidation and the formation of trusts.

Last December the Supreme Court of the United States, in the now popularly known "Hardwood Decision" (American Column & Lumber Co. et al. vs. the United States of America), decided that the "open competition plan" as interpreted and administered by the American Hardwood Manufacturers' Association was intended to and did restrict production and restrain competition and increased rather than stabilized prices. The plan required members to make daily reports of sales, shipments, copies of orders and invoices, monthly production, stocks, and any changes in prices as soon as made. This information was gathered and distributed by skilled employees of the association to the members only and was supplemented by a regular monthly meeting for a discussion of subjects of interest to members. The court held that this arrangement afforded an opportunity for combining upon agreements expressed or implied, and that the evidence showed beyond discussion that the purpose of the organization, and especially of the frequent meetings, which were held several times a month, was to bring about a concerted effort to raise prices.

The Hardwood Manufacturers' Association maintained in its defense that the data distributed among its members were of the same nature as the reports contained in newspapers regarding commodities bought and sold upon the organized exchanges. The court, however, called attention to the "distinguishing and sufficient difference" that the reports in the press go to the buyers and sellers alike; the trade association's compilations were confined to its members and subject to interpretation by skilled officials.

At first it was thought that this decision would have an adverse effect on the existence of trade associations, but it is now realized that it applied only to that particular case, and referred to a trade association organized to exploit the "open-price" plan and to use its statistical information for its own ends. It has, however, been a lesson to some bodies to steer clear of any steps that would tend to restrict competition.

Secretary Hoover's interest in the trade association has been so deep that he has corresponded with the Attorney General to learn definitely those activities in which the trade association may engage without being prosecuted. The Attorney General was careful to make the important reservation in his reply to Secretary Hoover, that whatever is done must not be a scheme to restrict production, enhance prices, or suppress competition. There is no objection to a trade association furnishing a standard system of accounting, provided costs are not exchanged by the members. The trade association may advocate uniformity in the use of trade names, provide for the standardization of quality and grades, provide standard forms for contracts, and standardize machinery and processes. It may determine means for eliminating waste, raise the ethical standards of the trade, collect credit information, handle the insurance of its members, engage in collective advertising welfare work, and urge legislation affecting the industry such as tariffs, taxes, transportation rates, employers' liability acts and other similar questions, tremendous activities in themselves. It may collect statistics from each member showing the volume of production, capacity to produce, wages paid, consumption and distribution, and stocks. This information may be compiled by the trade association into a consolidated statement showing total volume of production, wages by districts, consumption in foreign and domestic trade, distribution, and stocks. After compiling this information the trade association may file the statement with the Secretary of Commerce for distribution by him to the members of the association through the public press and to the public generally. There seems to be no objection to a trade association collecting statistics of prices received for past sales data which may be consolidated into one report, without, however, giving individual information to any member of the association. The consolidated report may be sent to the Secretary of Commerce for public distribution.

Engineers have frequently been indicted as poor business men and narrowly technical. It is not without some measure of pride that they can point to the efforts of Secretary Hoover to introduce an engineering search for the facts on which trading, prices, prosperity, and other business elements are built. One of his steps in that direction is to make better use of the trade association in what he has characterized as "groping for stability"—a vivid expression. The mining industries need not be told what a great aid it would be to eradicate the plunges from capacity production to complete closure—from phenomenally high prices to unusually low ones.

Bureau Calcining Dolomite

The investigation of dolomite cements will be continued at Columbus, Ohio, by the U. S. Bureau of Mines, Free lime in dolomite cements, calcined above 800 deg. C., causes excessive shrinkage and cracking in the finished cements. Dolomite cements, containing practically no free lime, may be prepared by calcining the rock at a sufficiently low temperature (below 800 deg. C.) to decompose the magnesium carbonate but not the calcium carbonate. The investigation will consist of calcining dolomite at a temperature high enough to decompose both the magnesium and calcium carbonates and adding suitable agents to react with the lime.

Investigation in Wisconsin Zinc District

Since the beginning of the milling to recover zinc, the Wisconsin field has borne an undesirable reputation on account of the marcasite which is associated with the sphalerite. The separation has been difficult. A fairly satisfactory process of magnetic separation for grading up jig concentrates which are contaminated with marcasite was finally developed and has for some time been in operation, but the fines are not amenable to this process and have been wasted. The purpose of an investigation conducted by the U. S. Bureau of Mines at the Wisconsin State Mining School, Platteville, is to utilize the fines. Since the year 1911 some of the mining companies have made an earnest effort to use the fines in the tailings but without satisfactory results being achieved.

Examination of the current mill tailings shows that the minus 20-mesh material therein is the most amenable to profitable re-treatment. The evidence so far gained is that by screening the tailings on 20 mesh, 65 per cent of the zinc content will be concentrated in the fines. The fines will amount to 25 per cent of the whole; that is, the ratio of concentration will be four to one and the recovery 65 per cent.

Laboratory tests indicate that concentrating tables placed in the mills to treat the fines will recover 90 per cent of the zinc content in a low-grade concentrate assaying about 20 per cent zinc, and that this concentrate can be graded up to 62 per cent in central plants where flotation and gravity concentration are combined. An estimate has been made that this practice would have added about one million dollars annually to the revenue for zinc. In some instances the lead recovered would have been appreciable. Two byproducts, marcasite and ground limestone, would have been available for sulphuric acid and agricultural purposes, respectively.

The work is conducted through a quadrangular cooperative agreement among the operators, the Wisconsin Mining School, the local assayer, and the Bureau of Mines. The laboratory results are encouraging and will probably lead to a commercial try-out of the process as soon as the zinc market encourages the operators to reopen their mines.

Georgia Kaolin in Pottery

English china clay is preferred to Georgia kaolin by many American potters. In comparing the two it is found that the English clay disintegrates in water more readily, produces a body which casts more satisfactorily, gives lower drying and bisque losses, requires less linseed oil to produce a spreading condition for oilcloth, and produces a paper of better finish and more resistent to moisture.

In the preliminary work by the Bureau of Mines it was found that after calcining Georgia kaolin to low temperatures (500 to 600 deg. C.) it possesses properties similar to the English china clay—i.e., its adsorptive properties are decreased to that of the English china clay and the rate of capillary flow and the permeability of water is increased. Further tests are to be made to determine its commercial feasibility. The effects of aging the calcined clay in air and water are to be studied to determine how far the calcined clay will revert to its original condition and also to determine the varieties produced by different calcination temperatures.

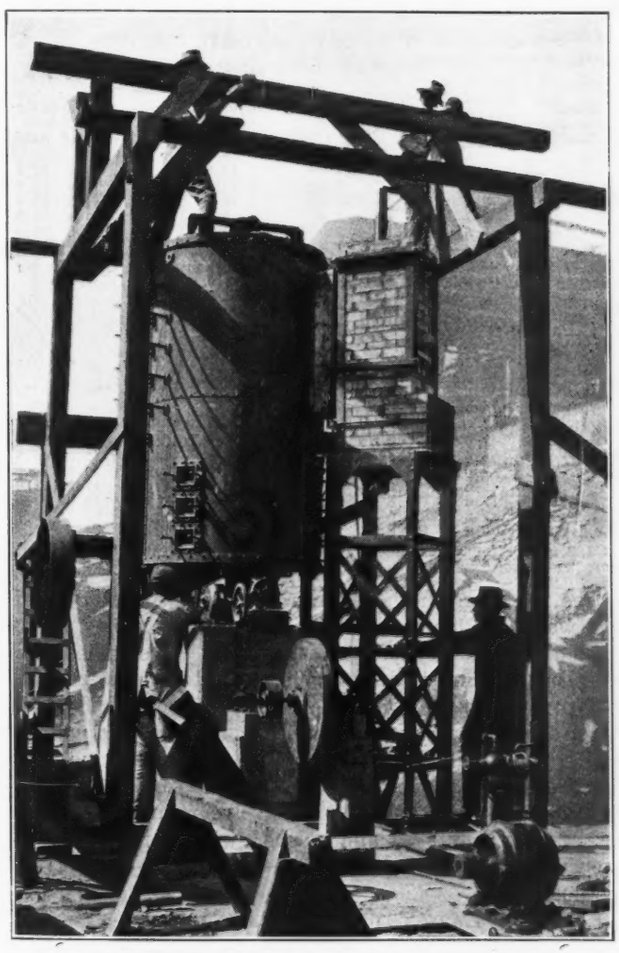
Sulphatizing Roasting of Semi-Oxidized Copper Ores

Process So Conducted as To Produce Maximum Content of Water-Soluble Copper—Close Temperature Regulation Necessary

By Percy R. Middleton
Consulting Metallurgist, New York

THE PRESENCE of oxidized copper minerals is one of the stumbling blocks in the efficient application of the flotation process to many copper ores. Although excellent recoveries of the sulphide are made, the greater part of the oxidized mineral is lost in the tailing. Numerous processes have been devised for the treatment of semi-oxidized copper ores, and they may be classified as follows:

1. Sulphiding, or filming the oxidized mineral with a sulphide, to make the particles more adaptable to the flotation process.



View of furnace during erection, showing Dutch oven and ports for oil burners on lower hearths

2. Combined flotation and leaching, the oxidized copper being leached with acid either before or after the flotation of the sulphides.

3. Solution of the acid-soluble copper, precipitation of the copper in the pulp, and the recovery of both metal and sulphide by flotation.

4. Roasting the ore, whereby a large percentage of the copper minerals is converted into the sulphate, and leaching the calcine with acid. The copper is recovered by any known method of precipitation.

This article will deal only with the last-named method.

The idea of the sulphatizing roast is by no means new, but hitherto has not met with much success. After considerable experimental work in both the United States and Australia, I patented (U. S. No. 1,376,025) a method of roasting which has given satisfactory results on both semi-oxidized and heavy sulphide copper ores. This method of roasting does not require special apparatus, and may be conducted in any standard type of roasting furnace. The results obtained depend on temperature control, and the operation may be divided into two stages as follows:

1. The ore is heated to a reacting temperature, below the ignition point of the sulphur in the ore. (By ignition point is meant the temperature at which a blue flame is distinctly visible over the surface of the ore; this flame is due to the rapid oxidation of the sulphur and is accompanied by a rapid rise in temperature of the charge which prevents the desired reactions taking place.) During this stage of the roast the direct oxidation of the copper and iron sulphides occurs presumably in accordance with the equation

$$3CuFeS_2 + O_{13} = Cu_2S + 3FeSO_4 + CuSO_4 + SO_2.$$

2. Following the completion of this direct oxidation, the temperature is gradually elevated to about 1,100 deg. F., further reactions occurring which may be expressed as follows:

$$Cu_2S + O_5 = CuSO_4 + CuO.$$
$$2Cu_2S + 2FeSO_4 + O_{11} = 4CuSO_4 + Fe_2O_3$$

From the above reactions it will be seen that the greater part of the sulphatizing action is due to the iron sulphate formed during the first stage of the roast, and it has been found that this compound also reacts with the oxide of copper, forming copper sulphate.

The possibilities of this method of roasting were demonstrated in a series of laboratory tests on various ores, the sulphur contents of which varied from 1.5 to 40 per cent sulphur. These small tests were so satisfactory that the manufacturers of the Herreshoff furnace supplied a small ten-hearth furnace for experimental work on a larger scale, and the following are particulars of a test conducted on a sample of ore from the Burro Mountain Branch of the Phelps Dodge Corporation.

The ore was crushed in a standard-type ball mill. An analysis of the crushed product gave the following results:

Sized Products: Mesh		Total Cu, Per Cent	Oxide Cu, Per Cent	Weight, Per Cent	Cumulative Weight, Per Cent
On	35	...	...	1.4	...
	48	2.09	0.11	4.0	5.4
	65	2.16	0.11	5.8	11.2
	100	2.39	0.19	6.4	17.6
	150	2.57	0.20	5.6	23.2
	200	2.65	0.33	12.0	35.2
Through	200	2.47	1.32	64.8	100.0

Copper, 2.49 per cent; oxide copper, 0.73 per cent; sulphur, 7.8 per cent; iron, 7.7 per cent.

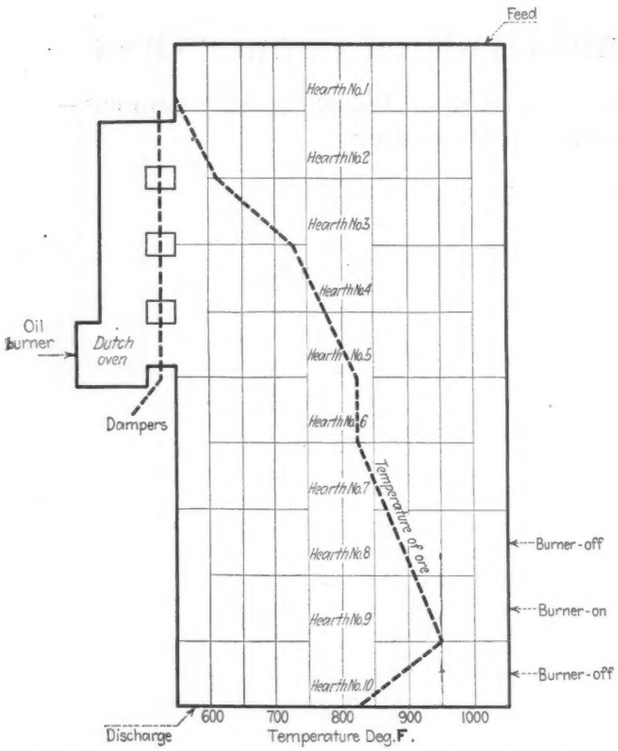


Fig. 1. Temperature range on various hearths

This crushed product was roasted in a ten-hearth Herreshoff furnace, 3 ft. hearth diameter. The second, third, fourth, and fifth hearths were heated by a Dutch oven, fired with an oil burner; the eighth, ninth, and tenth hearths were each provided with a burner, and in this manner heat could be applied to any part of the furnace. In operation, only one burner was used on the lower hearths, which, together with the Dutch oven, brought the temperature of the upper hearths up to the reacting point of the first stage of the roast. Each hearth, with the exception of the first, was fitted with a thermocouple, connected through a multi-point switch with a Brown indicating pyrometer and arranged in such a manner that the actual temperature of the ore bed was recorded. Fig. 1 is a graphic illustration of the temperature throughout the furnace under the most favorable roasting conditions. The temperature of each hearth was recorded every fifteen minutes and entered in a log book for reference. Samples from the furnace discharge were taken every fifteen minutes and a composite for each four hours was assayed for total and soluble copper. In addition to these discharge samples, a daily sample was taken from each hearth, to show the progress of the roast; Fig. 2 shows the soluble copper content of a series of hearth samples and also the temperature throughout the furnace at the time of taking the samples.

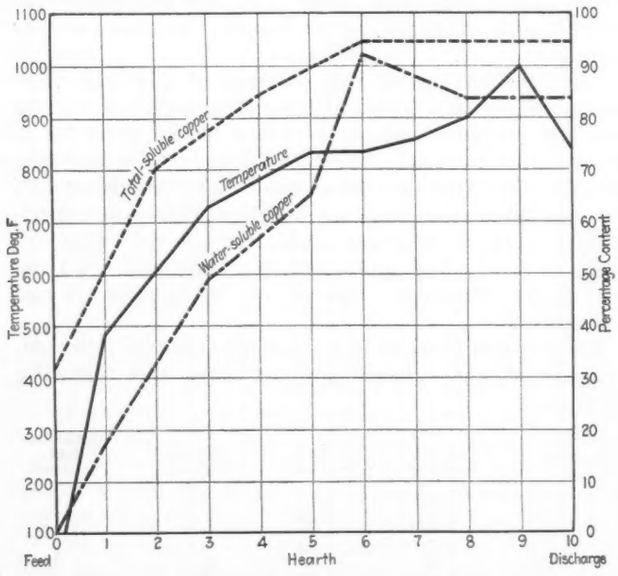


Fig. 2. Copper content and temperature of material on different hearths.

The experiments extended over a period of eleven days, and the total amount of ore treated was 17,272 lb. The amount of ore roasted per day, together with the results of the daily assays of water- and acid-soluble copper, is shown in Fig. 3. Analyses of sized composite samples of the calcines produced during the test are as follows:

ANALYSIS OF SEVEN-DAY COMPOSITE CALCINES

10,052 lb. Ore Roasted

Sized Products: Mesh		Weight, Per Cent	Cumulative Weight, Per Cent	Total Cu, Per Cent	Total Soluble Cu, Per Cent	Water-Soluble Cu, Per Cent	Per Cent Cu Soluble in Water	Per Cent Cu Soluble in Acid
On	35	1.6	....	....	....	....	....	....
	48	3.6	5.2	1.89	1.51	0.86	35.5	79.8
	65	10.2	15.4	2.62	2.37	1.32	50.4	90.5
	100	8.8	24.2	2.62	2.50	1.61	61.5	95.4
	150	8.2	32.4	2.81	2.60	2.40	85.4	92.5
	200	7.8	40.2	2.78	2.75	2.42	87.0	99.0
Through	200	59.8	100.0	2.47	2.37	2.09	88.2	96.0

Cu, 2.52 per cent; soluble Cu, 2.39 per cent; water-soluble Cu, 2.02 per cent; per cent of Cu soluble in water, 80.2; in acid, 94.9.

ANALYSIS OF FOUR-DAY COMPOSITE CALCINES

7,220 lb. Ore Roasted

Sized Products: Mesh		Weight, Per Cent	Cumulative Weight, Per Cent	Total Cu, Per Cent	Total Soluble Cu, Per Cent	Water-Soluble Cu, Per Cent	Per Cent Cu Soluble in Water	Per Cent Cu Soluble in Acid
On	35	2.0	....	1.54	0.68	0.13	8.5	45.0
	48	4.4	6.4	1.97	1.31	0.70	35.6	66.5
	65	7.0	13.4	2.42	1.80	0.83	34.3	74.4
	100	5.6	19.0	2.77	2.18	1.03	37.2	78.8
	150	12.8	31.8	2.87	2.32	2.12	74.0	81.0
	200	7.8	39.6	2.89	2.62	2.39	82.7	90.7
Through	200	60.4	100.0	2.53	2.30	2.14	84.6	91.0

Cu, 2.65 per cent; soluble Cu, 2.26 per cent; water-soluble Cu, 1.79 per cent; per cent of Cu soluble in water, 67.6; in acid, 85.3.

The following methods were used in estimating total and water-soluble copper:

Total Soluble Copper. Two grams of the sample were weighed out and boiled for five minutes in 50 c.c. of a 3 per cent solution (by volume) of sulphuric acid. After filtering and washing with hot water, the copper was estimated in the filtrate by the electrolytic method.

Water-Soluble Copper. Two grams of the sample were weighed out and boiled for five minutes with 50 c.c. of water, filtered and washed with hot water and copper estimated in the filtrate by the electrolytic method.

Easy Temperature Control

No difficulty was experienced in the operation of the furnace, and it was found possible to hold any hearth within 25 deg. F. of the desired temperature. In actual practice it would be advisable to use automatic temperature-control pyrometers, which operate the oil burners and keep the temperature within a few degrees of that desired. Owing to the small hearth area of the furnace used on this experimental work, no actual figures were obtained as to the capacity of a large-size furnace, but it is estimated that a ten-hearth 21 ft. 6 in. diameter furnace would treat from 200 to 250 tons of ore per day of twenty-four hours.

The above-outlined experimental work was conducted on the assumption that either sponge or scrap iron would be available for precipitation. With this in view the furnace was operated to produce a calcine containing as much water-soluble copper as possible, so as to reduce the acid consumption to a minimum. However, if the electrolysis of the leach solutions had been contemplated, the furnace product from the above test would not have been suitable, on account of the large amount of copper sulphate in the calcine, which would result in the regeneration of an excess of sulphuric acid over the requirements of the process and the discarding of a large quantity of solution at each cycle in order to keep the acid contents of the circuit constant. High water-soluble copper is not desirable in a calcine when electrolysis is the means of precipitation to be employed.

Roasting experiments show that to obtain a high total solubility it is necessary to sulphatize practically all the sulphide copper; in other words, the roasting of the sulphide direct to the oxide does not give satisfactory results. However, when the sulphate has been formed it can readily be converted to the oxide by increasing the temperature on the lower hearth of the

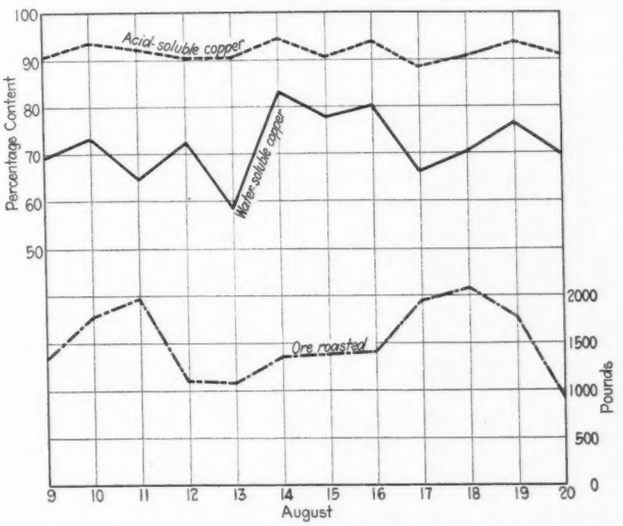


Fig 3. Copper content and tonnage treated each day

furnace to the decomposition point of copper sulphate, which begins at 1,200 deg. F. and is practically complete at 1,300 deg. F., the following reactions taking place:

At 1,200 deg. F.

$$2CuSO_4 = 2CuO, SO_3$$

or

$$2CuSO_4 = CuO + CuSO_4 + SO_3$$

At 1,300 deg. F.

$$CuSO_4 = CuO + SO_3$$

It has been found possible so to control the decomposition of the copper sulphate that the calcine produced will contain practically any desired percentage of the total copper in the water-soluble form and in this way regulate the regeneration of acid to the requirements of the process.

The treatment of the calcine for the recovery of the soluble copper will not present great difficulty; in fact, the latest methods used in cyanide plants may be applied with a few minor modifications. For example, the Dorr counter-current system of decantation may be applied either to the whole of the furnace product or to the slime only, after making a separation of sand and slime. In the latter operation the sand would be treated by percolation in tanks fitted with filter bottoms. The application of electrolysis to the recovery of copper from leach solutions has been successful in two large plants, and there is no doubt as to this feature of the process.

Looking at the matter from the commercial standpoint, the following working costs have been compiled, and for comparison an estimate has been made of the cost of treating the same ore by flotation and smelting. The relative cost of plants is not considered:

ROASTING COSTS PER TON
BASIS: 200 TONS PER FURNACE PER DAY

	Cents
Fuel; 6 gal. oil @ 5c	30
Labor; one man per furnace per shift @ $4	6
Power, repairs and miscellaneous	9
Total	45

TREATMENT COSTS, ROASTING AND LEACHING. BASIS 1,000 TONS PER DAY. ORE CONTAINING 2 PER CENT CU (0.75 PER CENT OXIDE)
Assume Recovery of 90 per Cent or 36 Lb. Cu per Ton

	Cents
Crushing	30
Roasting	45
Leaching	20
Precipitation, @ 3c. per lb. Cu	108
Freight and casting cathodes, @ 1c. per lb. Cu	36
Selling expenses, @ 0.15c. per lb. Cu	5
Total	244
Cost per lb. of Cu	6.79

TREATMENT COSTS PER TON. FLOTATION AND SMELTING
Assume Recovery of 70 per Cent or 28 Lb. Cu per Ton

Milling, including crushing, flotation and miscellaneous	$1.50
Freight on concentrate to smelter	0.15
Smelting concentrate, per ton of ore	0.50
Freight and refining blister @ 1.5c. per lb. Cu	0.42
Selling expenses @ 0.15c. per lb. Cu	0.042
Total	$2.612
Cost per lb. of Cu	9.32 c.

SUMMARY
Treatment Costs per Lb. Cu.

	Cents
Flotation and smelting	9.32
Roasting and leaching	6.79

Balance in favor of roasting and leaching, 2.52c. per lb. Cu.

The experiments conducted on Burro Mountain ore indicate that this class of material may be roasted and a calcine produced containing at least 90 per cent of the copper in soluble form, which may be extracted by a modification of the apparatus used in modern cyanide work, and the copper recovered from the leach solutions either by electrolysis or by precipitation on scrap or sponge iron. The only novelty in the process is the roasting, which can be conducted in any standard type of ore-roasting furnace.

Investigation of Georgia Clays By Bureau of Mines

The kaolins and bauxites of Georgia occur principally in the coastal plain, the belt running diagonally across the state from east to west. The lines of the Central of Georgia R.R. reach about 80 per cent of the white clays and bauxites of the coastal plain. The white clays are being mined at a few points, principally at Gordon, Claymont, McIntyre, and Butler, and are sold principally to the filler trade. Bauxite mining has been carried on in the Cuthbert, Toomsboro and Andersonville districts.

The investigation undertaken by the Ceramic Station of the Bureau of Mines, at Columbus, Ohio, in co-operation with the Central of Georgia R.R., will consist in experiments to devise better refining methods and to test the physical properties of the different separations obtained.

Philip Argall

An Appreciation by T. A. Rickard

PHILIP ARGALL died on March 19 at Denver, Col. He was the son of a Cornish mining engineer. His life of sixty-eight years was full of useful work and persistent study. As a boy he had few educational opportunities, but he made the most of those that offered. At the age of sixteen he was working ten hours per day in the ore-dressing plant of an Irish copper mine and learned the first principles not only of concentration but of the leaching of copper ore. A Dublin professor gave him a blow-pipe and a few books. With these he started to study minerals and rocks. He grew up among mines and metallurgical plants, and used his

Philip Argall

scientific curiosity to good purpose. When twenty-one he was a shift boss in another Irish mine, and soon became superintendent. He had begun already to write on geology, and throughout his life he was as willing to give information as he was eager to gather it. When twenty-five he was given charge of a detinning plant at Swansea, in Wales, and showed his metallurgical ingenuity by devising a new way of smelting the slag. Then he went to Cornwall, and formed professional ties with the firm of Rickard Bros., for whom later he traveled in Australia and elsewhere. He was manager of the Kapanga mine, in New Zealand, for a year. In 1887 he became manager of the La Plata smelter and began his long association with the mining industry of Colorado. When the sulpho-telluride ores of Cripple Creek presented a new metallurgical problem, he set about to devise a method for their successful reduction; and he succeeded in adapting cyanidation to this purpose, by aid of fine crushing and preliminary roasting. He designed several successful mills, including the Metallic plant at Florence. Later, when the flotation process came into use, he played a conspicuous part in adapting it to the treatment of zinc ore in New Mexico. In 1903 the Institution of Mining and Metallurgy (London) awarded him a gold medal for his paper on "Sampling and Dry Crushing in Colorado." During the last years of his life he was engaged in the microscopic study of free gold in quartz and in sulphides from all over the world, and spent some time in the laboratory of the U. S. Geological Survey at Washington, where he conducted an interesting research, the result of which will be published, I hope, by one of his sons. He was the father of five sons, two of whom—Philip and George—were in partnership with him. On them he bestowed a much better education than he had been able to obtain for himself, so that he left the United States five good citizens—nay eight, for his three daughters also are citizens of the best type. Philip Argall would have won the warm regard of Theodore Roosevelt, because he reared and educated a large family of capable sons and daughters; he and his wife gave the United States the best return that a citizen can give to his adopted country. Although born in Ireland, he was of Cornish origin, but he exercised his privilege of becoming an American citizen as soon as he established his residence in Colorado. He was a notable example of a man that makes the most of his opportunities; he was an eager student throughout his life; he was keen to devise new metallurgical methods; he made many notable contributions to technical science; he was willing always to take part in the public discussion of technical affairs; he was a helpful man, and therefore a highly civilized man. He said that his "best achievement" was the introduction of the eight-hour shift in the cyanide mills of Colorado. That bespeaks his humane feeling for his fellow-workers. It would be well if such a sentiment could be labeled American. At any rate, Philip Argall was a splendid American in spirit, in initiative, in capacity for hard work. The mining profession in the United States has reason to be proud of him, and to hold his memory in honor.

Briquetting Zinc-Bearing Material For Distillation

As a step in the electrothermic smelting of zinc ores, some large-scale briquetting tests were initiated on roasted ore and on a zinc residue concentrate at the Mississippi Valley Experiment Station of the U. S. Bureau of Mines at Rolla, Mo. Briquets were made of ore, coke, and pitch, and were shipped to a smelter at Fort Smith, Ark., for distillation in the retorts of a natural gas fired furnace. Ordinary retort distillation on the residue concentrate (containing 36.0 per cent Zn, 9.5 per cent Fe, 21 per cent Pb, 3.1 per cent CaO, and 3.2 per cent S) results in a low recovery of zinc and rapid destruction of retorts. The distillation of this material in briquet form resulted in 97 per cent zinc extraction, although only 70 per cent was recovered, owing to cold furnace fronts on account of a low firing of the furnace for the experimental work. Retort destruction is practically nil with the briquets, and a larger charge can be handled in retorts when in briquet form. This work is to be continued on a practical scale at Fort Smith, and the installation of an electrothermic unit to handle blue powder and dross is under consideration.

USEFUL OPERATING IDEAS

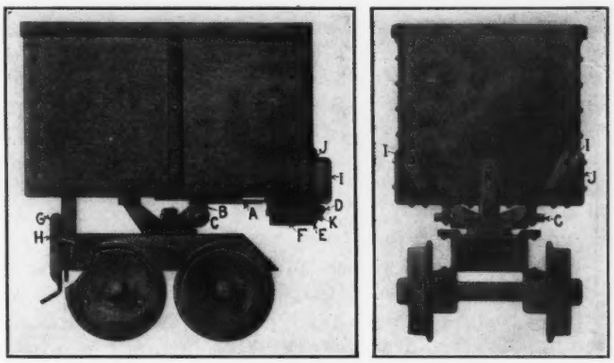
Improved Automatic Mine Car

Body Latch Operated by Foot, Remaining Open —Tilting Thirteen Degrees Releases Door— Both Devices Positively Locked

BY L. S. FARNHAM

AS A RESULT of observed deficiencies and need of improvement in the usual type of mine car in Butte and most Rocky Mountain mining districts, the Davis-Daly Copper Co.'s engineering and mechanical force has designed, built, and placed in operation an automatic latching and unlatching mine car, which bids fair to displace the standard type of lever-latched cars now in use in the company's properties.

The typical Western mine car has a lever at its rear end which releases successively the body, for tilting,



Automatic mine car developed and used by Davis-Daly Copper Co.

and the door for dumping its contents. The failure of this lever, with its attached hook rod and the co-acting body and door, to function effectively is the principal cause of accident, delay, and annoyance with the car. The lever is often hard to move, on account of its hook or latch rubbing the door, which is pressed against the latch by its load of rock. When the car is to be dumped at the side of the track, turning the body 90 deg. on the bolster or turntable on top of the truck, the lever must be moved far enough to unhook the body from the truck, but not sufficiently to unlatch the door until the car has been turned. Sometimes the lever sticks and then lets go with a jerk, opening the door too soon and dumping part of the load on the track.

Often, when dumping straight ahead into a chute or skip or over the edge of a dump, the car is run against the stop at sufficient speed to tip by its momentum, but, by the lever sticking, the operator fails to unlatch either body or door, and the car, with load and truck, is tipped into the chute or skip or over the dump, with the door closed. It is then a laborious and troublesome job to get the car righted. A man has sometimes been taken over with the car and seriously injured. The lever, being placed at the rear end of the car, is subject to bumping from other cars and requires more repairs than any other part. It not infrequently catches the operator's fingers and injures them. The improved car eliminates this lever entirely and utilizes the tilting movement of the car to release the door.

Experience has shown that, to be serviceable and "fool proof," a car with automatic door release and body latch must have positive locking devices on both of these pieces of mechanism. With this purpose in mind, the car embodying this feature has been designed and is now in operation. This combines mechanism which will unlatch the rear of the car body from the truck, independently of the car door latch; keep the catch unlocked as long as desired, and latch the same automatically after dumping the car. It will also unlatch the car door automatically for either end or side dump, whenever the bottom of the car has been raised to an inclination of 13 deg. from the horizontal, and not before; latch the door again upon returning the body to the horizontal, and positively lock the door in such position as to insure against the latch opening accidentally by knock or jar which might cause the door to be opened and the contents to be discharged in such a manner as to cause a wreck in drift, crosscut, or hoisting shaft. The locking device for the door latch is so arranged that it cannot lock until the door is fully in place, so that should the door fail to latch automatically by its own weight, after dumping, it can readily be kicked back into place.

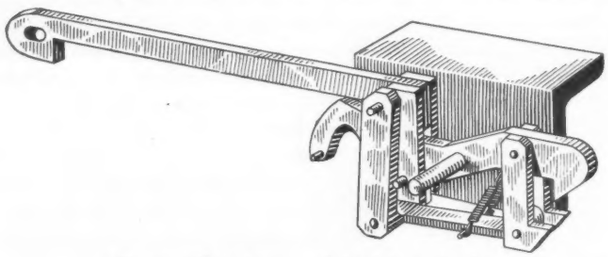
The door is positively released by a lever (*A*) connected to the turntable at (*B*) eccentric with the pivot (*C*) of the car body, releasing the latch (*D*) when the body has been tilted at an angle of about 13 deg. In closing, the door automatically latches, and is positively locked by a secondary latch (*E*), auxiliary to latch (*D*). The latches (*D* and *E*) are free to open independent of the lever (*A*), except when the door is closed; then the latch (*D*) is positively locked by its auxiliary latch (*E*), which acts on the end of the lug (*K*), attached to the door, to prevent latch (*D*) from being raised.

The latching mechanism is composed of six simple forgings and four light coil springs, mounted on a pair of 3½ in. angles (*F*) riveted to the bottom of the car body. The forgings are of simple shapes, and can be made and repaired by the ordinary blacksmith. They are assembled almost entirely by use of pins and cotters, and can easily be changed, without special tools, when worn out or accidentally broken, and without taking the car to the shops. The working edges of latches are case-hardened.

The car body is secured in the rear to the truck frame by a latch (*G*), which is released by a foot treadle. This latch is held open by a pawl (*H*) until the body is tilted, and latches automatically when the body is returned to its original position. This feature of holding the latch open has the advantage of allowing the operator to release the latch while the car is approaching the dump, thus permitting him to stand

with both feet on the ground or with one foot on the wheel, in the most convenient position for him while dumping the car. Dumping the car straight ahead, where the wheels strike a stop, is extremely convenient. The treadle is pressed by the foot when the car nears the stop, and, moving with slight impetus, the car dumps itself without any effort by the operator, the door never failing to release positively.

The typical car, if it has any form of bumper, usually has it so placed as to strike the door of a contacting



Door releasing and locking device.

car, inside of its edge, so as to bend it inward when cars come together with some force. This is one of the most common accidents and necessitates frequent repairs, which are avoided by the improved car here described. The bumpers are 2½ in. angles (*I*), riveted across the lower corners of the door, and extending beyond the sides and bottom plates and reinforcing bands (*J*) of the body of the car, thus insuring that all the bumping strains will be taken up by the sides and bottom, rather than by the door and the end plates.

The car dumps equally as well over the side as on the end, the door release being so constructed that the body can be tilted sufficiently to give ample clearance in revolving, without the door opening. It is adaptable to either center draw-bar or side-chain pull.

These cars have been in test operation for five months, under actual working conditions, and are giving satisfaction. Patent has been applied for by the inventors, J. L. Bruce, S. A. Worcester and L. S. Farnham.

Buckets and Bucket Accessories

Buckets are used in prospecting, sinking, and to a small extent in ore hoisting. The commonest type is cylindrical, with the bail attached close to the upper edge. Barrel-shaped buckets are also employed under some conditions. In the former type, the bucket edges are rounded in to prevent catching under the shaft timbers. The barrel type, on account of the larger middle diameter, is less likely to catch timbers. To facilitate dumping, bucket bails are sometimes attached below the middle part of the bucket, and a locking device to prevent overturning when hoisting is attached either to the bucket or to the bail. A safety shackle, or "sister hooks," is necessary for the rope attachment. Bucket sizes range from several hundred pounds' capacity up to one or two tons.

As ordinarily used, buckets are likely to sway from side to side, and to prevent this crossheads and guides are preferably used. The crosshead is a simple timber frame through which the rope passes and which is raised and lowered with the bucket. A type of "safety crosshead" with automatic safety catches is also used to some extent and is to be preferred to the ordinary forms. Hoisting buckets weigh from 30 to 40 lb. per cu.ft. of capacity.

Value of Diamond Drill in Prospecting for Oil and Gas

The experience of W. K. Gordon in using the diamond drill for oil and gas prospecting in Texas, according to the California State Mining Bureau, has led him to conclude that

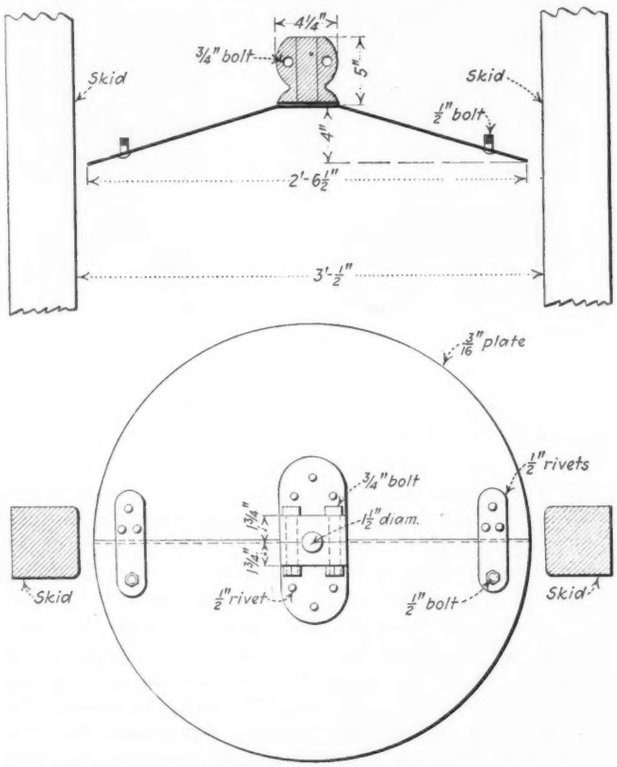
1. The diamond drill can be operated at less cost than the percussion drill to depths less than 1,000 ft. At greater depths the time consumed in removing cores and running tools back into the hole cuts down the footage per day.

2. Quicksands, surface waters, and caves necessitate reducing the diameter of the hole from, say, three inches to smaller, to case off water and sand. This reduction of hole soon eliminates any practical value of the diamond drill in testing for oil.

3. Gas will show in diamond-drill holes, but oil will not. Oil-stained cores of an oil-bearing formation have been taken, but they gave no indication of the quantity of oil in the stratum.

Protecting Shield for Shaft Repair Men

A circular steel shield for the protection of repair men working in a shaft has been devised by the Ivanhoe Gold Corporation, of Kalgoorlie, Western Australia. This is a shallow cone made in halves to facilitate its



Steel shield used by Ivanhoe Gold Corporation to protect shaft repair men

removal, as shown in the accompanying sketch, which is reproduced from the report of the Department of Mines of Western Australia. A device of this kind, varied to suit different shaft conditions, is desirable in shafts where, by reason of their depth, the velocities of the smallest falling bodies cause them to become dangerous to the life of the workmen who may happen to be employed in the shaft.

THE PETROLEUM INDUSTRY

Immediate Oil-Well Drilling Advocated by Bureau of Mines

Delay in drilling into an oil structure or sands after they have been opened up may cause losses of from 5 to 50 per cent in the ultimate amount of oil produced from the well, according to a statement issued by the U. S. Bureau of Mines.

Oil is an underground nomad. It moves through the deep sand layers, propelled by the gas pressure behind it, ever searching for the opening through which it may spout or be pumped to the surface. The first wells penetrating the sand operate under high pressure, but those drilled after the gas pressure has been reduced almost without exception come in for a much smaller initial production.

In fields where small tracts form a "checker-board," drilling in any one tract forces the owner to the adjoining tract to begin an immediate drilling program. If he delays drilling, he will see oil which might have been his coming from his neighbor's well, and the longer he delays drilling his offset well the less oil will his well yield. It is only when a structure has not been "tapped" and has no faults along the edges through which the oil may seep that it is possible to conserve oil underground.

One of the "game laws" of the oil fields corresponds to an English law regarding deer which provided that, no matter how many differently owned pieces of land the deer crossed in its flight, it was the property of the owner of the land on which it was killed. Regardless of the number of tracts under which the oil may pass in a structure, it belongs to the owner of the well through which it leaves the ground.

The men in the oil fields know this and know also that the early driller gets the most oil. If an owner of a tract neglects to drill and thereby loses the oil which passes under his land to another well, he must accept his loss without complaint. It is an axiom of the oil fields that, if a man wants oil, he must drill.

Studies made by an engineer of the Bureau covering a great many wells in Oklahoma, Louisiana, and California show that the loss due to delay in drilling is in places as much as 50 per cent. The seriousness of this loss is shown in the following extracts from his report, now in manuscript form and to be published in the future as a Bureau of Mines bulletin:

"During the early life of a pool, wells are brought in with large initial production. As the pool becomes older, there is a marked decrease in initial production of new wells, due to a fall in gas pressure. Naturally, a loss in recovery per acre results, being due to drainage of gas and also in some cases to drainage of oil. The drainage factor is important to the operator if his property has not been protected properly by line wells. In order to obtain the maximum amount of oil from a tract in a pool where there are other operators, a fast drilling program is necessary, thus obtaining wells of large initial production and consequently large ultimate production."

In three typical fields of Oklahoma, the Adair pool, the Bartlesville-Dewey district and the Nowata district, losses in total recovery of oil from adjoining wells varied from 5 to 53 per cent when all conditions were apparently similar except time of drilling. The greatest difference was between two adjoining wells, one of which was drilled in 1905 and had an ultimate production of 5,785 bbl. per acre and the other drilled in 1906 for an ultimate production of 2,700 bbl. per acre. Delay of one year in drilling caused a loss of 3,085 bbl. per acre to the second driller.

Another example cited is in Buena Vista Hills, Midway field, California. Here the ultimate recovery for a certain drilled-up tract which is at least as favorably situated as an adjoining drilled-up tract is estimated to be 24 per cent less per acre, due apparently to a delay of two years in drilling.

In the Hewitt field of Oklahoma, four wells on ten acres all came in for more than 500 bbl. per day initial production. One and one-half months later a neighbor's offset well came in for 220 bbl. the first twenty-four hours, and four months later an offset well made only 120 bbl. the first twenty-four hours.

"It is evident from the records," the Bureau of Mines report says, "that the production of oil from these wells is directly dependent upon the gas pressure included in and associated with the oil. The loss in the initial production of wells due to delay in drilling reflects the loss in pressure, and varies with the number and proximity of producing wells in the same pool, the size of the pool, and the time of delay in drilling."

Petroleum Notes From Texas

SPECIAL CORRESPONDENCE

Several interesting oil developments have been made recently in Texas. In Young County the Ralco Oil Co. has completed its No. 1 Roark well, making 2,000 bbl. of oil from 3,780 ft. This production is made from the top of the gray lime, similar to that in Stephens County but at greater depth. The well is situated southeast of the Bunger district, in the southern part of the county and north of the Stephens-Palo Pinto County line. The Pioneer district, Eastland County, was extended about one mile east by the completion of the Diamond Drilling Co.'s well, making about 450 bbl. of oil and much gas from 2,475 ft. Ten wells are producing in this district, drilling is increasing, and leasing is active. Prices for outlying acreage have increased greatly. Both the shallow and deep proved areas of the Electra field, Wichita County, have been extended. Many new wells would now be drilling if the water supply were sufficient.

In the coastal fields, Orange is the most actively developed. On March 29 the Gulf Production Co. brought in its Lee Hager well, making 4,000 bbl. through a

choker from 3,940 ft. This well is of much interest, as it is east of Cow Bayou. The plank road to the field has been completed, making it possible to haul in five-ton loads. At Barbers Hill, Chambers County, the Texas Co. has acquired leases on 1,600 acres around the northwest, north, and northeast sides of the dome. Drilling on this block must begin within sixty days. The White Point Development Co., drilling a deep test for oil in the White Point gas field, passed through a gas-bearing stratum in its new well at 1,430 ft. The pressure was strong. Pierce Junction received a temporary setback when a tornado blew down seventeen derricks.

It is believed that two new salt domes in the coastal belt have been discovered recently. Eight miles south of Richmond, in Fort Bend County, the Gulf Production Co. struck what is believed to be the cap rock of a dome in its No. 1 Wheat well at 600 ft. A later report stated that the well was standing full of oil. The second dome is in Jackson County, where the Jackson County Oil Syndicate is drilling near Horseshoe Lake, six miles northwest of Edna. Here the No. 1 Drushel well developed gas pressure at 2,600 ft. sufficient to blow the drill stem from the hole, and a second blowout stuck the drill stem in the well and necessitated its abandonment. No. 2 well, a short distance to the east, is drilling below 1,300 ft. with strong gas pressure at 900 ft. A surface dome at Horseshoe Lake is additional evidence of the possibility of this being a salt dome.

Analysis of Louisiana Crude Oil

A representative sample of crude oil from the Haynesville, La., field has been analyzed by the Bureau of Mines with the following results:

Gravity	34.7	deg. Bé.
Sulphur	0.42	per cent
Carbon residue of residuum	7.26	per cent

Distillation by the Bureau of Mines, Hempel method, showed approximately, the following results:

Gasoline and naphtha	21	per cent
Kerosene	16	per cent
Gas oil	15	per cent
Light lubricating distillate	16	per cent
Medium lubricating distillate	6	per cent

The gravity of the crude is comparable with that of the crudes obtained from the Rocky Mountain district, and the sulphur content is not unusually high. The gasoline and naphtha content is moderate, and the percentage of gas oil is large. The magnitude of the figure for the carbon residue of residuum probably indicates that the residuum can be worked up into cylinder stock by proper chemical treatment.

Syndicate To Drill in British Columbia

SPECIAL CORRESPONDENCE

A syndicate of Vancouver and Seattle business men, which owns 350 acres of natural gas and petroleum leases at Hall's Landing, near Revelstoke, B. C., has made arrangements to drill the area, and work will be started as soon as the necessary machinery can be procured. Considerable excitement was created in this district last year by the discovery of natural gas issuing from the surface, and a large amount of ground was covered by gas and oil leases.

Petroleum Refineries Show Large Increase

Petroleum refineries in the United States on Jan. 1, 1922, numbered 479 completed plants, with 30 additional plants in process of construction, according to a statistical summary prepared by H. J. Lowe, petroleum economist of the U. S. Bureau of Mines. The indicated daily refining capacity of these plants is 2,164,050 bbl. of crude oil.

Texas at present leads all other states in the volume of oil refining business, with 63 operating plants, with a daily capacity of 345,150 bbl.; in addition, the state had on Jan. 1, 46 refineries shut down and 9 other plants were being built. Oklahoma is the second state in number of refineries, with 54 operating and 43 shut down; operating plants in this state had a daily capacity of 234,650 bbl. California, with 34 operating plants, was refining 314,360 bbl. daily. Pennsylvania had in operation 48 plants, with a daily refining capacity of 114,930 bbl. New Jersey, with but 5 refineries, treats 224,000 bbl. of oil daily.

The importance recently attained by the State of Louisiana in this industry is indicated by the fact that 14 refineries were treating 114,350 bbl. daily, and 11 plants were shut down. Kansas, with 19 operating plants, was refining 57,650 bbl. daily; Illinois, with 12 plants, was handling 62,050 bbl.; Wyoming, with 11 plants, was refining 89,900 bbl.; and Indiana, with 5 plants operating, was reported to be handling 54,300 bbl. daily.

Copies of the directory of petroleum refineries in the United States may be obtained from the Bureau of Mines, Washington, D. C.

Red River Bed Ownership in Doubt

SPECIAL CORRESPONDENCE

The State of Arkansas has entered the list of claimants to the bed of Red River. This matter is now under suit before the Supreme Court between the Government, the states of Texas and Oklahoma, and private individuals. Arkansas, under a motion for permission to intervene in the dispute, filed by Attorney General Utley of Arkansas, also asserted its title to a large portion of Texas. In this petition declaration is made that the boundaries of Arkansas laid down in the act of admission to statehood extend not only to the bed of Red River but over that part of Texas lying between the Louisiana boundary and the 100th degree of longitude and north of the thirty-second parallel. The Supreme Court has not yet decided whether it will consider this claim in connection with the Texas-Oklahoma Red River boundary case.

Oil-Shale Plant Starts Operation

The $300,000 oil-shale extraction plant of the Index Oil Shale & Refining Co., at De Beque, Col., is making its initial try-out with apparent success, treating about 250 tons every twenty-four hours, from which the extraction is approximately 60 gal. of crude oil per ton of shale.

Operations of the plant have demonstrated the necessity of minor changes in equipment, and the management announces that as soon as the required machinery can be installed the plant will be operated continuously. Contracts, it is reported, have been let for two other plants in this field.

SOCIETIES, ADDRESSES, AND REPORTS

Trade Associations' Work Vital to Industry

Hoover Advocates Publicity in Statistics—Chairman Gaskill of Federal Trade Commission and Senator Edge Outline Government's Views

BY FELIX EDGAR WORMSER

ALTHOUGH it was Secretary Hoover's plan to hold the Washington conference on trade association activities in the Department of Commerce building on April 12, the attendance was so large that it was necessary to adjourn to the larger auditorium of the Department of the Interior. Several hundred trade association executives listened to Secretary Hoover's opening address, in which he outlined the useful field of the association in foreign trade, simplification of trade products and practices, and the elimination of waste in industry. It was his duty under the law, he said, to promote trade, and one of the methods of doing so was presented by closer co-operation with the trade association. "Contact can only be secured through trade and industrial organizations, for without organization there can be no representation. We hold that the legitimate trade association work is vital and should be encouraged." Only a small minority were engaged in activities which brought them under suspicion. Activities on the border line of legality or in the twilight zone were secondary. Mr. Hoover emphasized the importance of making public statistical compilations covering production, consumption and stocks.

Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, and Mr. Durgan, of the Division of Simplified Practice, expressed a willingness on the part of their bureaus to work with the legitimate trade associations. Dr. Stewart, of the Census, said that it was a tremendous job to gather and publish promptly statistics of all the country's industries.

Secretary Hoover called upon many of the representatives the trade associations present to get their viewpoint. Some of them said that they were already furnishing the Department of Commerce with a complete record of their statistics and advocated the fullest publicity in that matter. Secretary Hoover urged the trade associations to get out of the twilight zone, to quit skating near thin ice, and to take a broad view of their functions. He believed that the war has brought about a fundamental difference in our economic life. Standards of living in other countries have been lowered and intense competition must be met.

Chairman Gaskill of the Federal Trade Commission suggested that the trade associations give closer attention to the competitive system under which society was organized, a system whose purpose was to give the greatest measure of social justice to all. Monopoly was destructive to competition, and all things tending toward monopoly must be weeded out. It was not a question of too much government in business or vice versa, but of the closer cooperation of both, to mutual advantage.

Secretary Hoover called upon Senator Edge, who said that he felt business should know where it is at, and to that end had introduced a bill designed to aid the trade associations in defining their activities. Co-operative help from Congress is as necessary to business as it is to agriculture, he declared.

A representative of a Southern trade association said that the conference writes a new page in the history of American business and would make April 12 memorable for that fact. Another said it afforded a golden opportunity to organize industry in harmony with the law and that each trade association should consult frankly with the Department of Commerce as to its activities. In fact, the discussion showed that each association had its own problems to contend with and that a general solution of all of them was not feasible.

The solicitor of the Departmtent of Commerce emphasized the voluntary nature of the support from trade associations, and that the department had no means of compelling or desire to compel them to give their aid or conform to certain regulations. Secretary Hoover in his closing remarks said that the conference was merely a meeting of information and education and was not sufficiently organized to go into details. He was ready to meet each association with its individual problems and to go into details with it. He stated that only about one-third of the associations compiled trade statistics and that the Department of Commerce has never attempted to impose a statistical service upon the associations. The voluntary statistical contributions of trade associations were gladly received and used.

Secretary Hoover said that the vital function of the trade association was as an educational body. Education is the foundation of business and the life of the country, he declared. The problems of business practices, ethics, and business contact with other activities were practically all educational. Trade associations might be considered as colleges of business in their own fields. When they stepped out of their educational work into the twilight zone of questionable practices the first step out was publicity—the elimination of secrecy.

Brass and Copper Officials To Eliminate Overlap

It was intimated by one of a party of operating officials of the American Brass Co., who recently visited Butte, at a session of the Butte Section of the A.I.M.E., that their coming to Butte was for commercial purposes and that the Anaconda officials would return the visit. The plan is to eliminate any duplication of effort from the production of copper to the manufacture of finished brass products, and thus effect a considerable saving in cost. The Anaconda Copper Company has in mind a cost reduction in a number of brass articles, such as nails, to promote their more general use, and plans are being developed with a view to widening the merchandising field. Anaconda now has its copper-shingle propaganda under way, and the inquiries which it is receiving indicate the awakening of a widespread interest in this venture. There appears to be little doubt as to the success which the copper shingle will attain once its merits properly are brought before the building trades and home constructors.

Labor Conditions in Tin Mines Of Nigeria

W. E. Thorne, consulting engineer for the Consolidated Goldfields, South Africa, entertained the San Francisco Engineers' Club on March 30, with an interesting description of the conditions under which mining work is effected in West Africa, under British control. Mr. Thorne said that in the working of the alluvial tin deposits natives were employed and had to be trained by the white men who went in to take charge of the properties. When properties were first opened transportation was effected by natives, who could each carry a head load of 75 lb. Heavy weights were loaded upon four-wheeled trucks pulled by men. Burros and camels were next used. Camel loads were limited to 800 lb. At present motor cars, power trucks, and caterpillars are used. White operators are judge, jury, and father to the natives, who are superstitious and childlike.

MEN YOU SHOULD KNOW ABOUT

E. L. Miller, Jr., has joined the faculty of the Missouri School of Mines.

J. F. Newsom left San Francisco on March 15 for the Federated Malay States.

E. C. Warrener, of New York, is visiting the Kirkland Lake and Porcupine camps.

James M. Davis, superintendent of the Cary mine of Pickands, Mather & Co., has resigned.

John Power Hutchins is in Berlin, engaged in a study of German-Russian commercial relations.

Lee Frasier and **E. Norris Hobert**, of the A. S. & R. Co., are in Mexico City on company business.

G. C. Bateman, general manager of the La Rose Mines, Cobalt, has been made a director of the company.

F. R. Short left San Francisco on March 15 for Mayo, Yukon Territory, to take charge of the Keno Hill, Ltd.

W. H. Wiley, of Los Angeles, is making an examination of the properties of the Jib Mining Co. at Basin, Mont.

J. M. Shiner, of Los Angeles, is installing an experimental leaching plant on the property of the Anita Copper Co. at Lordsburg, N. M.

S. T. Kelsey, who has represented the International Society of Forestry and Mining in the Belgian Congo for several years, is visiting Ferndale, Cal., where he will remain for several months.

Henry S. Burnholz has been appointed mining engineer with the drill-steel investigations which are conducted under the joint supervision of the U. S. Bureau of Mines and the Bureau of Standards.

B. M. Concklin, chief engineer of the Arthur Iron Mining Co., at Hibbing, Minn., has returned from Washington, D. C., where he was attending to taxation matters relative to the properties of his company.

Glen Brandow, who has been in charge of the flotation plant of the East Butte Copper Mining Co., has left for Silver Plume, Col., where he will be associated with the operation of the East Butte's Pelican mill.

B. F. Hewett is making a geological reconnaissance of the Atlanta and Pioche districts, in Nevada. Before returning to Washington he will report on the underground water supply in the immediate vicinity of Searchlight, Nev.

H. C. Hixon, assistant general manager of the Mineral Point Zinc Co., of Chicago, is visiting zinc properties in New Mexico. He responded to a request from the State School of Mines at Socorro and delivered a comprehensive lecture on the subject of zinc.

Albert Burch, of San Francisco, chairman of the California Section of the A. I. M. E., addressed the Montana Section, at its annual meeting in Butte, the last week. Mr. Burch, who is eminent in the geological field, is in Butte in the interests of the Davis-Daly Copper Mining Co.

C. W. Wright, manager of the Soc. Romes per Esplorazioni Minerarie, Rome, Italy, has been appointed by **Dr. F. W. McNair**, president of the Michigan College of Mines, to represent that institution at the celebration of the seventh centenary of the Royal University, Padua, Italy.

E. C. Reeder, for the last five years chief engineer of the Rosiclare Lead and Fluorspar Mining Co., in charge of exploration, development, and construction work at Rosiclare, Ill., resigned on March 1 to enter the employ of the Hillside Fluor Spar Mines, of the same place, in a similar capacity.

R. T. Stull, who has been superintendent of the Columbus, Ohio, Experiment Station of the Bureau of Mines, has been appointed assistant chief of the Bureau's mineral technology division. In that position he will have technical supervision over the work in non-metallics and in ceramics.

F. D. Foley, a Bureau of Mines metallurgist, who has been in charge of iron and steel investigations at the Minneapolis Experiment Station, has been selected to take immediate charge of the investigation of breakage and heat treatment of rock-drill steels and other steels and alloys subjected to similar impact stresses.

William B. Daly, assistant manager of the Anaconda mines, was elected chairman of the Montana Section of the A. I. M. E. at its ninth annual meeting held at Butte, Mont., on March 25. Other officers chosen were: **L. V. Bender**, of Anaconda, vice-chairman; **E. B. Young**, of Butte, secretary-treasurer; **George T. McGee**, of Helena, and **E. N. Norris**, of Butte, members of the executive committee.

Mining and metallurgical engineers visiting New York City last week included: **Dwight E. Woodbridge**, of Duluth, Minn.; **George A. Packard**, of Boston, Mass.; **S. A. Ionides**, of Denver, Col.; **A. C. Bunker**, of El Paso, Tex.; **J. M. Sickler**, of Denver, Col.; **Ernest G. Robinson**, of Moore, Mont.; **John Davenport**, of Wausau, Wis.; and **H. S. Mulliken**, of Washington, D. C.

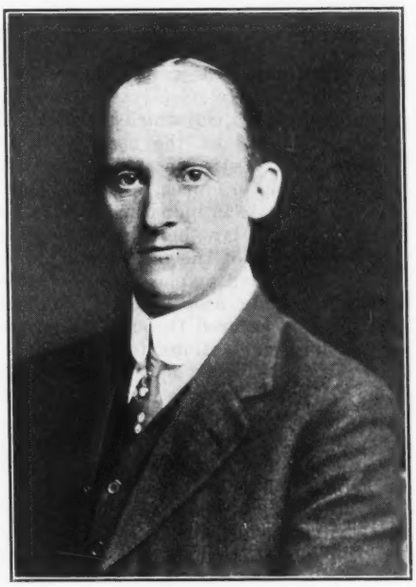
OBITUARY

Edward F. Russell was killed by a fall in the shaft of the Helen Ray mine, at Nogal, N. M., on March 29.

Prof. Hjalmar Sjögren, director of the Mineral Department of the State Natural History Museum, Academy of Science, Stockholm, Sweden, died recently. Dr. Sjögren had visited the United States several times. He was a member of the A. I. M. E. and the author of several papers which have appeared in the *Transactions*.

George J. Salmon died of pneumonia on March 2 in Philadelphia. Mr. Salmon was graduated from the Pennsylvania State College in 1914, and was first engaged as engineer for the New Rivers Collieries Co., at Eccles, W. Va. In 1920, he worked with War Mineral Resources Commission in Washington, and at the time of his death was supervising engineer with the U. S. Bureau of Mines, engaged in the leasing of public coal mines.

Knox Taylor, president of the Taylor-Wharton Iron & Steel Co., died on April 4 at his home at High Bridge, N. J. Mr. Taylor was the fifth generation of his family to manage the company, which was founded in 1742. He was



Knox Taylor

born at High Bridge, Oct. 19, 1873, son of the late William Johnston Taylor and of Mary Alward Taylor. He began his education at Chester, N. J., where for a time his father operated an iron blast furnace. Later he attended the Hill School at Pottstown, Pa., the Model School at Trenton, and was graduated from Princeton University with the degree of Bachelor of Science in 1895. In college he was a member of the track, athletic and football teams, and was selected as all-American guard. Mr. Taylor's love of outdoor life led him to engage in mining engineering work in the Rocky Mountains for seven years after leaving college. He was a member of several clubs and associations, among them being the Engineers' Rocky Mountain and University clubs, American Society for Testing Materials, American Institute of Mining and Metallurgical Engineers, American Chemical Society, American Society of Mechanical Engineers, Society for Promotion of Engineering Education and Iron and Steel Institute (England).

THE MINING NEWS

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Leading Events

THE FORDNEY TARIFF BILL was finally reported to the Senate on April 10. A full account is given in this issue in News from Washington on pages 640-2.

The hearing on the accounting between the Butte & Superior and Minerals Separation companies, set for April 11, was again postponed.

Sale of Consolidated Arizona's holdings, scheduled for April 7, was negotiated in spite of the Treasury Department's lien for excess profits taxes which was filed last week.

Legislation effecting trade associations has been proposed in Congress. Such organizations would be brought under the Federal Trade Commission should the present bills become law.

Operators in the Coeur d'Alenes, Idaho, are encouraged by the recent advance in the price of lead. Two companies now shut down may resume.

The number of companies active in the Joplin-Miami district continues to increase, but production remains stationary.

Arizona Hercules Property Sold at Sheriff's Sale

By Telegraph to "Engineering and Mining-Journal Press"

Florence, Ariz., April 10—The property of the Arizona Hercules Copper Co. has been sold at sheriff's sale at Florence for $3,600,000 to representatives of the Empire Trust Co., of New York, acting as agents for the reorganization bondholders. The reorganization referred to is that of the subsidiary Ray Hercules Copper Co., now the Ray Hercules Mines, Inc.

Poland To Open State Oil Fields

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 10—According to a dispatch received from Warsaw, the government has decided to open the state oil fields in southern Poland to private exploitation. The production of petroleum in Poland last year declined approximately one-third, as compared with the output for 1920.

Replogle Acquires Empire Steel and Iron Co.

The Replogle Steel Co. has acquired the Empire Steel & Iron Co. The former controls the Wharton Steel Co., which owns the Replogle or Scrub Oak mine near Wharton, N. J., as well as two modern furnaces at Wharton. The Empire company operates the Mt. Hope and Washington mines in the same state. The purchase will add 250,000 tons to the producing capacity of the Replogle company. The latter has also secured control of the Mt. Hope Mineral Railroad. Leonard Peckitt, president of the Empire Steel & Iron Co., will be elected president of the Replogle Steel Co.

Consolidated Arizona Holdings Sold Despite Tax Lien

By Telegraph to "Engineering and Mining-Journal Press"

Prescott, Ariz., April 10—The property of the Consolidated Arizona Smelting Co. at Humboldt, Ariz., was sold at Prescott on April 7 to J. L. McNeil, a Colorado banker representing the Southwest Metals Co., for $1,000,000. This was the only bid made at the sale. Robert M. Thompson, of New York, was also one of the leading backers of the new corporation. G. M. Colvocoresses, who has been receiver, will be general manager of the new corporation. He says that the $600,000 claim of the Government for excess taxes is not warrantable, and can be settled satisfactorily. It is planned to start the smelter about June 1.

Magma Copper Bonds Offered

Directors of the Magma Copper Co. have authorized the issue of $3,600,000 ten-year 7 per cent convertible debenture bonds, convertible into stock on the basis of thirty shares for each $1,000 bond or fifteen shares for each $500 bond. The bonds will be offered to stockholders for subscription and arrangments to underwrite the issue have been made.

Anaconda Co.'s Tailings Plant About to Resume

By Telegraph to "Engineering and Mining-Journal Press"

Butte, Mont., April 11—The Anaconda Copper Mining Co. will ship sixteen carloads of copper wire and rods to London, beginning April 12, on a rush order. The company's slime and tailings plant is preparing to resume and will treat 3,200 tons daily.

Argument Heard in Tom Reed Apex Case

By Telegraph to "Engineering and Mining-Journal Press"

Phoenix, Ariz., April 10—The Supreme Court of Arizona has heard the argument in the apex case of the Tom Reed Gold Mines Co. against the United Eastern Mining Co.

Japan Increases Duty on Copper

Japan has put into effect decided increases in the rates of duty applying to copper, according to cable advices to the Department of Commerce. The rate on copper ingots and slabs has been increased from 60c. a picul (133 lb.) to $3.50 per picul. The increase on copper bars and rods is from $4.45 to $7.50 a picul. The increase on copper plates and sheets is from $4.98 to $8 a picul. The cable dispatch states that the action is necessary to protect Japan's domestic copper industry.

Calumet & Jerome Defendants Make Answer

Answer has been made by the defendants in the Superior Court at Prescott, Ariz., in the case of J. O. Brown against the Calumet & Jerome Copper Co., George W. Avery, George H. Avery, and Joe Larson. It is asserted that Brown is merely a dummy stockholder, representing brokers, that the Averys have been directors ever since organization of the corporation in 1907, that much development work has been done, that there are no debts or bonds outstanding, and that the suit was instituted at the instance of certain New York brokers who became incensed when they were not given a contract to refinance the company.

News from Washington

By PAUL WOOTON
Special Correspondent

Senate Committee Reports Tariff Bill With Many Changes

Elasticity Secured by Powers Granted to President—American Valuation Abandoned—Bonded Warehouse Provision Rewritten—10 Per Cent Duty on Cyanide

IN AN EFFORT to meet an unprecedented economic situation, the Senate Finance Committee, after nearly nine months of study, has reported out an elastic tariff. To give the final draft of the measure the flexibility which the Senate committee believes to be necessary, fundamental changes had to be made in the bill which was passed by the House of Representatives last July.

Ad Valorem Duties Based on Foreign Value

The Finance Committee based ad valorem rates on the foreign values of imported merchandise. The American valuation plan as embodied in the bill passed by the House was abandoned because of the limited number of exactly comparable domestic and foreign products and the difficulty and probable litigation involved in defining comparability to the satisfaction of importers, domestic manufacturers, and customs officials. The committee feared disturbance to business while these difficulties were being adjusted.

Chairman McCumber states that the plan of assessing ad valorem duties on the American selling price of the imported articles was abandoned largely because of the unstable basis for assessing duties growing out of the importers' profits when selling in the American market. In many instances, he states, the importer's margin was over 100 per cent of the foreign cost price. A painstaking investigation of the question of margins between the foreign price of an article and the importer's selling price in this country was conducted for the benefit of the committee. In the light of the information thus disclosed it was decided to be far better to use the time-tried method of foreign valuation.

Elasticity in the tariff has been provided, the committee believes, by authorizing the President to modify rates within prescribed limits; to change the basis of ad valorem duties on certain items from the foreign value to the value of the domestic article in the American market; to impose penalty duties and prohibit the importation of particular goods; and to impose additional duties against any country which discriminates against the United States.

Never before in the history of tariff making has there been such acute conflict between the domestic mining industries and the consumers of mineral raw materials. The Senate committee made a large number of important changes in the House bill. Tin was put back on the free list. Arsenic, bismuth and cadmium, which formerly were on the free list, were made dutiable. The duty on magnesium metal was reduced by one-half. The quicksilver duty was reduced from 35c. to 25c. per lb., but a corresponding compensatory duty was placed on fulminate of mercury and other products containing quicksilver. The rates on zinc metal were increased slightly by the Senate committee so as to make them higher than the rates applying to the ore. Manganese ore and iron pyrites were placed on the free list. The House rates on tungsten ore were retained, but the specific rate on ferrotungsten was reduced. The rate on magnesite was fixed at four-tenths of a cent a pound in an effort to place the domestic product on an equal basis with the material imported from Central Europe at the chief steel-producing centers in the United States.

10 Per Cent Duty on Cyanide

One of the surprises of the bill was the action of the Senate committee in making cyanide dutiable at 10 per cent ad valorem.

The rates of duty on metals and ores and other articles of concern to the mining industry, as contained in the bill, are as follows (the items are mentioned in the order in which they appear in the bill):

Refined bauxite, ¼c. per lb.; potassium, aluminum sulphate, ¾c. per lb.

Antimony oxide, 1½c. per lb. and 25 per cent ad valorem.

Chemical compounds, mixtures and salts, of which gold, platinum, rhodium, or silver constitute the element of chief value, 25 per cent ad valorem.

Cobalt oxide, 20c. per lb.

Potassium cyanide, sodium cyanide, all cyanide salts, and cyanide mixtures, combinations, and compounds containing cyanide, 10 per cent ad valorem.

White acetate of lead, 2½c. per lb.; brown, gray or yellow acetate, 2c. per lb.; nitrate, arsenate and resinate, 3c. per lb. All other lead compounds not provided for, 30 per cent ad valorem.

Morate, resinate, sulphate and all other manganese compounds and salts not especially provided for, 25 per cent ad valorem.

Calcined magnesia, not suitable for medical use, ¾c. per lb.

Phosphorus, 8c. per lb.

Barytes ore, crude or unmanufactured, $5 per ton; ground or otherwise manufactured, $10 per ton; precipitated barium sulphate, 1¼c. per lb.

Litharge, 2½c. per lb.; orange mineral, 3c. per lb.; red lead, 2¾c. per lb.; white lead, 2½c. per lb.

Zinc oxide and leaded zinc oxides, containing not more than 25 per cent of lead, 1¾c. per lb.; mixed with oil or water, 2¼c. per lb.; lithopone and other combinations or mixtures of zinc sulphide and barium sulphate, 1¾c. per lb.

Strontium, carbonate, nitrate and oxide, 50 per cent ad valorem.

Thorium nitrate, oxide and other salts of thorium, cerium nitrate, cerium fluoride and other salts of cerium, 45 per cent ad valorem.

Magnesite brick, $\frac{1}{10}$c. per lb., and 10 per cent ad valorem. Chrome brick, not glazed, 25 per cent ad valorem; glazed, 35 per cent ad valorem.

⅝c. Per Lb. on Calcined Magnesite

Crude magnesite, $\frac{1}{16}$c. per lb.; caustic, calcined magnesite, ⅝c. per lb.; dead-burned and grained magnesite, not suitable for manufacture into oxychloride cements, $\frac{4}{10}$c. per lb.

Crude gypsum, 25c. per ton; ground or calcined, $1.40 per ton.

Pumice stone, unmanufactured, valued at $15 or less per ton, $\frac{1}{10}$c. per lb.; valued at more than $15 per ton, ¼c. per lb.

Mica, unmanufactured, valued at not above 15c. per lb., 4c. per lb.; valued above 15c. per lb. 25 per cent ad valorem; cut or trimmed and mica splittings, 30 per cent ad valorem; mica plates and built-up mica, 40 per cent ad valorem; ground mica, 20 per cent ad valorem.

Talc, crude and unground, ¼c. per lb.

Graphite or plumbago, crude or refined: Amorphous, 10 per cent ad valorem; crystalline, crystalline lump, chipped or dust, 20 per cent ad valorem; crystalline flake, 2c. per lb. The term "crystalline flake" as used by the Senate committee is specified to mean "graphite or plumbago which occurs disseminated as a relatively thin plate throughout its containing rock, decomposed or not, and which may be or has been separated therefrom by ordinary crushing, pulverizing, screening or mechanical concentration process, such flake being made up of a number of parallel laminæ, which may be separated by mechanical means."

Metallurgical and chemical articles and utensils of all kinds, finished or unfinished, composed wholly or in chief value of glass or paste, 75 per cent ad valorem.

Spiegeleisen containing more than 1 per cent of carbon, $1.25. Spiegeleisen for the purpose of the act is specified to be "an iron-manganese alloy con-

taining less than 30 per cent manganese."

Molybdenum ore or concentrates, 75c. per lb. on the metallic molybdenum contained therein.

45c. Duty on Tungsten Ore

Tungsten ore or concentrates, 45c. per lb. on the metallic tungsten contained therein.

Ferromanganese containing more than 1 per cent carbon, $2.50 per ton. Ferromanganese for the purpose of the act is specified to be "such iron-manganese alloys as contain 30 per cent or more of manganese."

Manganese metal, manganese silicon, manganese boron, and ferromanganese and spiegeleisen containing not more than 1 per cent of carbon, 20 per cent ad valorem.

Ferrotungsten, metallic tungsten, molybdenum, molybdenum powder, calcium molybdate and all other compounds and alloys of molybdenum, $1 per lb. on the molybdenum contained therein and 15 per cent ad valorem.

Ferrotungsten, metallic tungsten, tungsten powder, tungstic acid, and all other compounds of tungsten, 60c. per lb. on the tungsten contained therein and 25 per cent ad valorem.

Ferrochromium-tungsten, chromium-tungsten, chromium-cobalt-tungsten, tungsten-nickel and all other alloys of tungsten not specially provided for, 60c. per lb. on the tungsten contained therein and 25 per cent ad valorem.

Ferrosilicon, containing 8 per cent or more of silicon, and less than 60 per cent, 2c. per lb. on the silicon contained therein; containing 60 per cent or more of silicon, and less than 80 per cent, 3c. per lb. on the silicon contained therein; containing 80 per cent or more of silicon, and less than 90 per cent, 4c. per lb. on the silicon contained therein; containing 90 per cent or more of silicon, and silicon metal, 8c. per lb. on the silicon contained therein.

Ferrochrome or ferrochromium containing 3 per cent or more of carbon, 3½c. per lb. on the chromium contained therein; containing less than 3 per cent of carbon, and chrome or chromium metal, 30 per cent ad valorem.

Ferrophosphorus, ferrotitanium, ferrovanadium, ferro-uranium, ferrozirconium, zirconium-ferrosilicon, ferroboron, titanium, zirconium, tantalum, chromium-nickel, vanadium-nickel, zirconium-nickel, chromium-vanadium, chromium-silicon, zirconium-silicon, calcium-silicon, and all alloys used in the manufacture of steel not specially provided for, 30 per cent ad valorem.

Cerium metal, $2 per lb.; ferrocerium and all other cerium alloys, $2 per lb. and 25 per cent ad valorem.

Steel containing more than six-tenths of 1 per cent of nickel, cobalt, vanadium, chromium, tungsten, molybdenum, or any other metallic element used in alloying steel, 10 per cent ad valorem, in addition to other rates prescribed. An additional cumulative duty of $1.25 per lb. on the molybdenum content in excess of six-tenths of 1 per cent is to be levied and 72c. per lb. on the tungsten content in excess of six-tenths of 1 per cent.

Duty on Laboratory Instruments

Scientific and laboratory instruments, apparatus and utensils, not specially provided for, 55 per cent ad valorem.

Aluminum, aluminum scrap and alloys of any kind in which aluminum is the component material of chief value, in crude form, 5c. per lb.; in coils, plates, sheets, bars, rods, circles, disks, blanks, strips, rectangles and squares, 9c. per lb.

Metallic magnesium, 50c. per lb.; magnesium alloys, 50c. per lb., and 20 per cent ad valorem.

Antimony, as regulus or metal, 2c. per lb.; needle or liquated antimony, ¾c. per lb.

Bismuth, 7½ per cent ad valorem.

Cadmium, 15c. per lb.

Metallic arsenic, 6c. per lb.

German silver, or nickel silver, unmanufactured, 20 per cent ad valorem; nickel silver in sheets, strips, rods, and wire, 30 per cent ad valorem.

Duty on Copper Products

Copper in rolls, rods or sheets, 2½c. per lb.; copper engravers' plates, not ground, and seamless copper tubes and tubing, 7c. per lb.; copper engravers' plates, ground, and brazed copper tubes, 11c. per lb.; brass rods, sheet brass, brass plates, bars, strips, etc., 4c. per lb.; seamless brass tubes and tubing, 8c. per lb.; brazed brass tubes, brass angles and channels, 12c. per lb.; bronze rods and sheets, 4c. per lb.; bronze tubes, 8c. per lb.

Aluminum or tin foil, less than six one-thousandths of an inch in thickness, 35 per cent ad valorem; bronze powder, aluminum powder, powdered foil, powdered tin, brocades, flitters and metallics, manufactured in whole or in part, 16c. per lb.; bronze or Dutch metal, or aluminum in leaf, 8c. per 100 leaves.

Gold leaf, 60c. per 100 leaves.

Silver leaf, 5c. per 100 leaves.

Quicksilver, 25c. per lb.

Azides, fulminates, fulminating powder and other like articles not specifically provided for, 12½c. per lb.

1½c. Duty on Lead Ores

Lead-bearing ores and mattes of all kinds, 1½c. per lb. on the lead contained therein: *Provided*, That such duty shall not be applied to the lead contained in copper mattes until after 2,000 tons of such lead shall have been imported in any one year, to be allocated under rules and regulations to be prescribed by the Secretary of the Treasury: *Provided further*, That on all importations of lead-bearing ores and mattes of all kinds the duties shall be estimated at the port of entry and a bond given in double the amount of such estimated duties for the transportation of the ores or mattes by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores or mattes at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the sample thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

2⅛c. Per Lb. on Lead in Bullion

Lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead, antimonial scrap lead, type metal, babbitt metal, solder, all alloys or combinations of lead not specially provided for, 2⅛c. per lb. on the lead contained therein; lead in sheets, pipe, shot, glazier's lead, and lead wire, 2⅜c. per lb.

Zinc Ores Under 10 Per Cent Free

Zinc-bearing ore of all kinds, containing less than 10 per cent of zinc, shall be admitted free of duty; containing 10 per cent or more of zinc and less than 20 per cent, ½c. per lb. on the zinc contained therein; containing 20 per cent or more of zinc and less than 25 per cent, 1c. per lb. on the zinc contained therein; containing 25 per cent of zinc, or more, 1½c. per lb. on the zinc contained therein: *Provided*, That on all importations of zinc-bearing ores the duties shall be estimated at the port of entry, and a bond given in double the amount of such estimated duties for the transportation of the ores by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the samples thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

Zinc in blocks, pigs, or slabs, and zinc dust, 1⅝c. per lb.; in sheets, 1¾c. per lb.; in sheets coated or plated with nickel or other metal (except gold, silver, or platinum), or solutions, 2c. per lb.; old and worn-out, fit only to be remanufactured, 1c. per lb.: *Provided*, That for a period of two years beginning on the day following the enactment of this act the rates of duty shall be as follows: On zinc in blocks, pigs,

or slabs, and old and worn-out zinc fit only to be remanufactured, 2c. per lb.; zinc in sheets, plates, strips, or coils, plated with nickel or other base metals, or in fabricated form, and zinc dust, 2½c. per lb.

Emory, corundum, and artificial abrasives, ground, pulverized, refined or manufactured, 1c. per lb.

Many Products on Free List

Among the articles on the free list are the following: Agates, unmanufactured; antimony ore; sulphide of arsenic; quicksilver flasks which have been exported from the United States; asbestos, unmanufactured; borax, crude; brass, fit only for remanufacture; Brazilian pebble; bullion, gold or silver; cerite or cerium ore; chalk, crude; chromite, or chrome ore; coal and coke; cobalt and cobalt ore; composition metal of which copper is the component material of chief value.

Also copper ore, regulus, black or coarse copper, copper cement, old copper and copper in plates, bars, ingots, or pigs not manufactured.

Also metallic mineral substances in a crude state, and metals unwrought, whether capable of being wrought or not; emery ore, corundum and crude artificial abrasives.

Explosives on Free List; Also Petroleum

Gunpowder and all other explosive substances used for mining, blasting or artillery purposes.

Iridium, osmium, palladium, rhodium, and ruthenium and native combinations thereof with one another or with platinum.

Iron ore, including manganiferous iron ore and the dross or residuum from burnt pyrites.

Manganese, oxide and ore of.

Minerals, crude, or not advanced in value or condition by refining or grinding.

Monazite sand and other thorium ores.

Petroleum, crude, fuel or refined.

Ores of gold, silver or nickel; nickel matte; ores of the platinum metals; sweepings of gold and silver.

Platinum, unmanufactured or in ingots, bars, sheets or plates, not less than ⅛ in. in thickness, sponge or scrap; potassium, nitrate, crude.

Sulphur in any form, and sulphur ore, such as pyrites or sulphuret of iron in its natural state, and spent oxide of iron containing more than 25 per cent of sulphur.

Tin ore and black oxide of tin; tin in bars, blocks or pigs and grain or granulated and scrap tin.

Uranium, oxide and salts of.

Duty on Potash for Five Years

Potash is grouped with the free list articles but carries a provision for duties during a period of five years. The paragraph reads as follows:

"Potassium chloride or muriate of potash, potassium sulphate, kainite. wood ashes and beet-root ashes, and all crude potash salts not specially provided for: *Provided*, That for a period of five years beginning on the day following the passage of this act there shall be levied, collected, and paid, on the actual potash (potassium oxide) content of all the foregoing a duty of 2½c. per lb. for the first two years; 2c. per lb. for the third year; 1½c. per lb. for the fourth year; and 1c. per lb. for the fifth year: *Provided further*, That thereafter the said potash content shall be free of duty."

Duty on Tin When U. S. Mines Produce 1,500 Tons Per Year

Tin ore is put on the free list with the following proviso: *Provided*, That there shall be imposed and paid upon cassiterite, or black oxide of tin, a duty of 4c. per lb. and upon bar, block, pig tin and grain or granulated, a duty of 6c. per lb. when it is made to appear to the satisfaction of the President of the United States that the mines of the United States are producing 1,500 tons of cassiterite and bar, block, and pig tin per year. The President shall make known this fact by proclamation, and thereafter said duties shall go into effect.

Bonded Warehouse Provision Changed

The Senate committee rewrote the provision in the House bill with regard to bonded smelting warehouses. As altered by the Senate, a commercial assay rather than a wet assay is provided. The text of the Senate provision is as follows:

"That the works of manufacturers engaged in smelting or refining, or both, of ores and crude metals, may upon the giving of satisfactory bonds, be designated as bonded smelting warehouses. Ores or crude metals may be removed from the vessel or other vehicle in which imported, or from a bonded warehouse, into a bonded smelting warehouse without the payment of duties thereon, and there smelted or refined, or both, together with ores or crude metals of home or foreign production: *Provided*, That the bonds shall be charged with a sum equal in amount to the regular duties which would have been payable on such ores and crude metals if entered for consumption at the time of their importation, and the several charges against such bonds shall be canceled upon the exportation or delivery to a bonded manufacturing warehouse established under the preceding section of this title of a quantity of the same kind of metal equal to the quantity of metal producible from the smelting or refining, or both, of the dutiable metal contained in such ores or crude metals, due allowance being made of the smelter wastage as ascertained from time to time by the Secretary of the Treasury: *Provided further*, That the said metals so producible, or any portion thereof, may be withdrawn for domestic consumption or transferred to a bonded customs warehouse and withdrawn therefrom and the several charges against the bonds canceled upon the payment of the duties chargeable against an equivalent amount of ores or crude metals from which said metal would be producible in their condition as imported: *Provided further*, That on the arrival of the ores and crude metals at such establishments they shall be sampled and assayed according to commercial methods under the supervision of Government officers: *Provided further*, That all labor performed and services rendered pursuant to this section shall be under the supervision of an officer of the customs, to be appointed by the Secretary of the Treasury and at the expense of the manufacturer: *Provided further*, That all regulations for the carrying out of this section shall be prescribed by the Secretary of the Treasury: *And provided further*, That the several charges against the bonds of any smelting warehouse established under the provisions of this section may be canceled upon the exportation or transfer to a bonded manufacturing warehouse from any other bonded smelting warehouse established under this section of a quantity of the same kind of metal, in excess of that covered by open bonds, equal to the amount of metal producible from the smelting or refining, or both, of the dutiable metal contained in the imported ores and crude metals, due allowance being made of the smelter wastage as ascertained from time to time by the Secretary of the Treasury."

I. C. C. Members Differ on Freight Rate Reductions

Decided differences of opinion exist among the members of the Interstate Commerce Commission in the matter of the proposed reduction in rates. Rumor has it that certain members believe that the railroads can afford no reductions at this time. Some believe rates can be reduced on basic commodities and others believe there should be a general reduction on all commodities. With such a situation existing it is obvious that a considerable delay may ensue. So far as coal is concerned, the psychological moment was passed when the decision was not handed down on April 1. Had it not been for the strike, the delay in handing down this opinion would have had a serious effect on the coal industry. The delay is discouraging buying of a large number of commodities.

It may be that the Interstate Commerce Commission will await the action of the Railroad Labor Board, as the decision in regard to wages has an important bearing on rates.

Colorado River Commission To Meet Aug. 1

The Colorado River Commission, of which Mr. Hoover is chairman, and whose business is responsible for his recent trip to the West, will meet again Aug. 1 at Santa Fe, N. M., to sum up details and report on the development project.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 8 amounted to 123,000 fine ounces. This brings the total purchases under the Pittman Act to 101,608,608, fine ounces.

Joint Rates to Foreign Points Considered by I. C. C.

Decision in International Nickel Case of Interest to Shippers Between U. S. and Mexico.

As there is difference of opinion among members of the Interstate Commerce Commission as to the interpretation of the Transportation Act with regard to jurisdiction over rates when part of the transportation takes place within a foreign country, the commission itself, in a decision rendered in the case of the International Nickel Co. vs. the Director General of Railroads, expresses the desire that the question be reviewed by the courts, so that they may establish judicially the extent of the commission's jurisdiction.

In the decision mentioned, the commission ordered reparation paid to the International Nickel Co. to cover unreasonable rates charged on blister copper, in carloads, from Port Colborne, Ont., to Constable Hook and Chrome, N. J. "The Grand Trunk hauled the shipments a little more than twenty miles, or less than 5 per cent of the total distance, but received as its division 35 per cent of the total revenue," says the opinion. "We must consider the reasonableness of the joint rate as a whole. We find that the charges assailed were unreasonable to the extent that they exceeded those that would have accrued at a rate of 23.5c per 100 lb." Commissioner Esch, dissenting, says, "It is clear from the report of the majority that the unreasonableness of the through rates assailed inhered in the divisions received for that part of the transportation which took place within Canada and that the charges received for that part of the transportation within the United States were not unreasonable."

The majority, however, bases its contention on previous decisions in which the position was taken that parties to a through rate are jointly and severally responsible for any damage that may result to a shipper on account of unreasonable charges. As the commission is without power to enforce an order against a Canadian or a Mexican railroad, it can hold the American participants in the rate severally responsible. Owing to the amount of the traffic in metals and ores between Mexico and the United States, the following excerpt which was cited by the commission in the International Nickel case is of pertinent interest:

"If the American line saw fit, it might doubtless name a rate to the Mexican border, and in that event we could deal only with the service up to the Mexican line. Instead of adopting that course the American carriers, in connection with the Mexican carrier, established a joint charge for the entire service from the point in the United States to the point in Mexico, and gave no information as to the part of that charge which would accrue to the American roads. This does not relieve the American carriers from obligation to impose a reasonable charge for their service; it does make it impossible for the commission to determine the reasonableness of that charge, except by examining the entire through rate.

"Clearly, we have no authority to establish a rate of transportation in Mexico; nor to order the maintenance of a rate for the future from a point in the United States to a point in Mexico; but we may require the American carriers to cease and desist from continuing to apply a joint through rate, or any rule, regulation, or practice in connection with that joint through rate, and we may, where such rate has been voluntarily maintained, inquire whether it has been reasonable, and if found unreasonable, award damages in that behalf."

Three War Mineral Awards Made

Awards recommended by the War Minerals Relief commissioner during the week ended April 8 were as follows: Frank Rose, $593.24; C. B. Parrott, $287.90 and Mrs. Maude E. Sisson, widow of Charles Sisson, $285.

Foreign Trade Increase Due to Mineral Shipments

An analysis of the increases in our foreign trade, Director George Otis Smith, of the U. S. Geological Survey, points out, shows them to be composed almost entirely of shipments of mineral products. Exports of agricultural and forest products contribute nothing to the increase. This leads Director Smith to ask if we are not basing our foreign trade too much on those crops of which there can be but one harvest.

Has Flotation Gone Too Far?

In view of suggestions and observations from various quarters, the question is asked at the Bureau of Mines if flotation has not gone too far in supplanting other methods of treating certain ores. There is a feeling that it is being overdone in some operations where good, clean mill work under the old system would result in greater profits. Though there is no tendency to dispute the important place that flotation holds, attention is directed to the fact that it is not the sole method of ore beneficiation.

Money Sought for Road Building in Alaska

To expedite the construction of roads, bridges, and trails in Alaska during the remainder of the current fiscal year, an effort is being made to put through legislation which will allow the board of Road Commissioners of the Territory to incur obligations prior to July 1 and make the payments out of the appropriations for the next fiscal year.

Mine Rescue Cars to Oil Fields

Owing to the demand in the oil fields and at the refineries for first-aid training, the Bureau of Mines has taken advantage of the idleness of coal mines in union territory to send several mine rescue cars into the oil fields. Another car is being sent into the lead district of southeastern Missouri on a similar mission.

Trade Association Legislation Proposed in Congress

Edge and McArthur Bills Put Such Bodies Under Federal Commission —Prosecution of Some Possible

Legislation defining the status of trade associations has been proposed in Congress by Senator Edge, of New Jersey, and Representative McArthur, of Oregon. They propose an investigation by a Congressional commission composed of three Senators and three Representatives of existing conditions of industry and commerce, requiring it to report by December next legislation defining the rights and limitations of co-operative organizations as distinguished from illegal combinations in restraint of trade. Such legislation would be designed to limit monopolies; eliminate waste in production and distribution; lower costs; simplify and standardize methods, and increase efficiency. The resolution proposing the investigation points out that business is now hesitating because it is unable to secure guidance which will clearly indicate proper lines of conduct.

The Edge and McArthur bills propose that trade associations shall be under the jurisdiction of the Federal Trade Commission. Exception is made of labor unions, associations of bankers or of railroads, or organizations for social, charitable or scientific purposes. Unless excused by it, each association would be required to file with the Federal Trade Commission a statement of its general character and proposed activities, the names and addresses of its members, officers, minutes of meetings and resolutions or agreement, express or implied, whether between members of the association or between the association or its members and others.

The bills would also require trade associations to file with the commission statistics collected by it as to production, shipments, stocks, contracts, prices, credit information, and all others respecting the trade. The commission may, if it sees fit, give publicity to such statistics for the public interest, and unless prohibited by the commission the association may distribute among its members statistics which have been filed with the commission. The bills would also authorize the commission to have one of its representatives at any meetings of the associations.

Representatives of the Department of Justice recently told the House Appropriations Committee that a large percentage of the business of the country is carried on by business men who belong to various trade associations. They said that the high cost of living is due in very large measure to activities of these associations. The department is investigating these associations on the theory that the recent Supreme Court decision in the lumber case does not close the door, and members representing associations consider that it does not apply to them. If given sufficient funds the department representatives said they would proceed energetically against some associations.

News by Mining Districts

London Letter

Globe & Phoenix' Report Shows Poorer Position—Mysore Gold Mining Co.'s 1921 Output Smallest Since 1903

BY W. A. DOMAN

London, March 31—On more than one occasion I have referred to the technical position of the Globe & Phoenix Gold Mining Co. (in Rhodesia), pointing out that with each development report the position appeared to become less satisfactory. The annual report and accounts have now been issued, and the view I have taken is fully corroborated. If one looks at the ore-reserve position, it is seen that, though the total ore developed as at Dec. 31 last shows a fairly substantial increase over the quantity developed twelve months ago, the value is considerably less. This will be apparent from the following: At December, 1920, the total ore was 93,852 tons, containing 145,321 oz., or an average of 1.548 oz. per ton, whereas at the end of December last the aggregate was 110,000 tons, containing 140,100 oz., equal to 1.273 oz. per ton. Taken as an average, this last-mentioned value is good, but the position alters when we look at the available ore.

At the end of 1920 the available ore was 47,380 tons, containing 62,753 oz. of gold, equal to 1.324 oz. per ton, and in the latest report the available ore has risen to 62,000 tons, containing 58,300 oz., or only .940 oz. per ton. The ore in pillars, and therefore unavailable, is 48,000 tons, containing 81,800 oz.

Last year the new tonnage brought in was 82,935, or approximately 16,000 tons above the quantity milled. The cost of this new ore was £27,728, of which £19,723 was redeemed, leaving £8,000 added to the previous figure in the balance sheet, so that the total of development is now valued at £31,131.

Owing to a strike on the mine early in the year, and to heavy taxation, plus a fall in the gold premium, profits were reduced considerably, for the net amount last year was only £82,121, as against £254,374 in 1920. For 1921 two interim dividends totaling £80,000 were paid, and this would not have been possible had it not been for the gold premium of £77,250. At the standard price of gold, the output realized £289,437, and as the total available ore has a value also at standard price of only £244,860, it follows that no final dividend is recommended. In point of fact, it was necessary, to show a good liquid position, to transfer £10,000 from the special development reserve of £100,000 to profit and loss account. This special development reserve was for the purpose indicated by the title, and the fact that 10 per cent of it has had to be taken for general purposes is regarded as rather discouraging. A considerable amount of development work was accomplished, but, generally speaking. it was unsatisfactory.

The principal operations were on the fourteenth level drive, in which, both north and south, 395 ft. were driven, of which 160 ft. were payable. David P. McDonald does not despair altogether, for he states that "at the bottom of the mine the reef maintains its patchy character, occasional good patches encouraging the hope that a new shoot may be near. From the appearance of the reef and its walls, the much-desired improvement in value may well be expected."

During 1921 the Mysore Gold Mining Co. crushed a smaller tonnage than in any year since 1903, the quantity being 202,289 tons, against 233,503 tons in 1920, and the yield 129,686 oz., in comparison with 156,800 oz. The revenue expenses per ton were 45s. 11d., or 3s. 7d. above the previous year's figure. The decline in the yield was due partly to a falling off in the gold content of the ore from 9 dwt. to 8.4 dwt. A favorable factor in working costs was the lower value of the rupee, the average of the exchange quotations during the year having been 1s. 4⅛d. while costs were increased owing to the greater amount of development work done, the addition being 6,691 ft. at 18,428 ft. The reserves of ore were estimated at the end of the year at 837,000 tons, as compared with 841,000 tons twelve months earlier.

SCANDINAVIA

Inquiry Into Kristianssand Company's Relation With British America Nickel Co. Ended

From Our Special Correspondent

Christiania—With the end of March the labors of the Government committee of inquiry into what, in Scandinavian circles, is termed the "nickel affair" provisiona'ly came to an end. The documents in the case have undergone scrutiny and the parties alleged to have been implicated have been granted time to furnish their statements in writing, after which the committee will resume its sittings.

The committee, after a cabinet meeting, was, by royal decree, on March 8 appointed to make searching inquiry into, and pronounce its critical judgment on the Kristianssand Nikkel Raffinerings Verk's and its trusted agents' relations with the British America Nickel Corporation, and the financing of the latter with the help of Norwegian capital.

The presence in the Norwegian parliament (Storthing) of twenty-nine Communist members plus eight Socialists renders the government one of compromise, and accounts for the haste of the ministry to take up the nickel affair, and, if necessary, throw any possible delinquents to the wolves.

The production of the Kongsberg Silver Mines, in Norway, in January, was: Kongens mine 543 kg.; Gottes Hülfe mine, 535 kg.; Gottes Gabe mine, 197 kg., and Samuel mine 1,017 kg. Total, 2,292 kg. of silver.

AUSTRALIA

Queensland

Mount Morgan Working Under Subsidy —New York Money Not for Steel Project

From Our Special Correspondent

Brisbane, Feb. 18—Work has been resumed at Mount Morgan mine. It will be two or three weeks before operations are in full swing. The government has increased from £1,000 to £1,100 per week the subsidy which it had promised to contribute to lessen the reduction in wages asked for by the company, and this has permitted the subsidy to be distributed among all employees instead of being limited to those coming under the industrial award, as had previously been insisted on by the labor unions. The company at first asked for a 20 per cent reduction in wages. The government subsidy will enable it to secure practically this reduction, but the men's wages will be actually reduced by an amount ranging from only 5 to 8 per cent. The government is also spending money at Chillagoe unprofitably to provide men with work, and as a result some people are demanding that it shall also bolster up other big companies, such as Mount Cuthbert, Hampden-Conclurry, and Mount Elliott, so that they also may resume operations, even with the price of copper down to a point as low as £58 per ton.

Some time ago the state government took over the copper mines known as the Mungana group, near the Chillagoe state smelter, paying a royalty on the output and having the option of purchase if developments proved satisfactory. These mines, with the Einasleigh copper mines, have been the chief source of ore supplies for the smelter. The Mines Department, on behalf of the government, has now purchased the mines outright and increased the force so that there may be ore enough to keep the furnaces running continously once they start.

Although the Queensland government has secured a second loan from New York, (£2,000,000), it is not intended to spend any of it on the proposed iron and steel works at Bowen, as it was thought would be done. Instead, the money is to be devoted to a big land settlement scheme and to the construction of railways, which will give work for the unemployed, who are far too numerous just now.

KOREA

Oriental Consolidated's March Clean-up Shows Improvement

Unsankinko—The March clean-up of the Oriental Consolidated Mining Co. was $91,000. A total of $73,703 was obtained in February, the mill tonnage being 14,428. The new Tabowie shaft was deepened 150 ft. in February and now lacks 400 ft. of reaching its objective.

CANADA

British Columbia

Cork Province May Resume Soon—Silversmith Running Steadily—Operators Ask Duty on Copper Product

Kaslo—The Cork-Province Mines, Ltd., owning extensive holdings on the South Fork of Kaslo Creek, plans resumption of operations about May 1. The property is equipped with a modern mill, and after some cleaning up and a little development will be in shape to make shipments. It has been on the inactive list for over two years.

Revelstoke—This season promises a decided revival of mining in the Big Ben country, north of this point. San Francisco capital is interested in leases of placer ground on what is known as Goldstream. Extensive tests made in 1916 are reported as being sufficiently encouraging to warrant undertaking dredging operations. Lode-mining activities in and around Revelstoke also promise interesting developments this season.

Trail—One of the chief hindrances to profitable handling of the Rossland ores at the Trail smelter is the high price of coke, which now costs $14 per ton, as against $7 per ton in pre-war times.

Ore shipments received by the Consolidated smelter March 22 to 31 totaled 13,168 tons, of which the company mines produced 13,151 tons, the Anna mine, Slocan City, 6 tons, and the Ottawa, at Slocan City, 11 tons.

Sandon—Since starting operations with the new mill early in the year, the Silversmith has had no difficulty in maintaining an output of approximately 400 tons per month. The concentrate is of high grade. Development of the mine is showing an additional increase in ore reserves. Up to the end of March the mill had not been operated to capacity, but it is likely that during the spring and summer a monthly production of around 500 tons of crude ore and concentrate will be maintained.

New Denver—Petitions are being circulated throughout the Slocan, and receiving numerous signatures, requesting the dominion government to abolish the 1c. per lb. duty on lead returned to Canada after being smelted from Canadian ores at American smelting and refining plants.

Grand Forks—An investigation has been made recently of the Granby smelter dam, on behalf of the Granby company and the provincial government.

Victoria—The Associated Boards of Trade of British Columbia, representing 40 boards of trade of every part of the province, at the annual meeting held March 30 passed a resolution requesting the dominion government to impose adequate duties on copper bars, copper rods, scrap copper and brass, sheet zinc and sulphate of lead.

Nelson—Completion of the raise between No. 2 and No. 3 levels of California mine, on Giveout Creek, three miles from this city, by the end of March, placed the property in good condition for continuous production. The California company has been developing since 1917, and secured a lease of the Athabasca mill, which has been remodeled. The plant has a capacity of 50 tons per day, and the ore will concentrate 5 to 1, mill heads averaging about $20 per ton. It is planned to start milling early in May.

Three Forks—Several of the towers of the aërial tramway connecting the Queen Bess and Idaho-Alamo mines with the Cunningham mill at Alamo were taken out by slides the latter part of March.

Britannia Beach—N. J. Quigley, vice-president of the Britannia Mining & Smelting Co. has been inspecting the company's properties on Howe Sound. Rebuilding operations are in progress at Britannia Beach. A new concentrator is being constructed, and the town, which was wiped out by a flood, is being rebuilt on a different site. C. T. Browning, general manager, states that the new equipment should all be in place and ready for use by fall.

Alice Arm—No announcement has yet been made as to the plans of the Taylor Engineering Co. for 1922 with reference to the Dolly Varden mine and railroad. The assumption is that, if development is not continued on the former, the railroad will operate at least to the extent necessary to handle the ore offering from properties of the district. There is a probability that work will be done on the Wolf group, north of the Dolly Varden, with a view to the proving of orebodies believed to belong to the same formations as those of the Dolly Varden.

Ontario

La Rose Directors Re-elected—Lake Shore to Enlarge Main Shaft

Cobalt—At the adjourned annual general meeting of the La Rose, the old board of directors were re-elected. The Toronto element, which put up a strenuous fight for control of the company, received only about half as many proxies as the present board. The company will reopen the old La Rose Extension workings, where a shaft 400-ft. deep was sunk, but no ore found. This work is being undertaken as a result of the geological re-survey of the Cobalt camp by C. W. Knight of the Provincial Geological Staff.

Good results are being obtained in the development of the Castle Trethewey since it was reopened recently. If the 260 level is as good as the upper levels a mill will be built.

The Dominion Reduction mill will not be reopened for the treatment of the Peterson Lake tailings, as the two companies find it difficult to come to terms.

Kirkland—The Lake Shore is preparing to enlarge the main shaft between the surface and the 400 level. Below 400 ft. it has three compartments, and another compartment will be added between the 400 level and the surface. Underground mining will be stopped until the work is completed, but there is sufficient ore on the dump to keep the mill running.

The stock of the Wright-Hargraves, one of the principal mines of Kirkland, with a capital of $2,750,000, has been listed on the Toronto exchange. It is largely owned in Buffalo. The company has paid dividends of 7½ per cent this year.

Porcupine—During the eleven months ended Feb. 28, the Dome profits were $1,145,000. Production is about 900 tons a day. The capital has been reduced by reducing the par value of the shares from $10 to $9 and by the payment of that amount to the shareholders as capital return.

Stock of the Davidson is being extensively offered and advertised in London. The offer embraces 800,000 5s. preference shares entitled to two-thirds of the annual profits until 100 per cent has been paid and thereafter 20 per cent non-cumulative dividends in priority to ordinary shares. English financial papers look upon this flotation with considerable reserve.

MEXICO

Mexico—The Pasadena El Monte Silver Mines Corporation will hold a meeting in Mexico City on April 27, to ratify the acts of the board of directors.

Broken Hill Co.'s Steel Project in Need of Protection

When the Broken Hill Proprietary Co., Ltd., of Broken Hill, Australia, launched its iron and steel works enterprise in 1915, the general manager, G. D. Delprat, stated that there would be no need for protection. The position now, however, has greatly changed, due primarily to the large increases paid for labor and supplies. In other words post-war conditions are quite different from those ruling in pre-war times. H. V. McKay, one of the directors of the company, and widely known as the manufacturer of the Sunshine Harvester, recently reviewed the position of the iron and steel industry. He said that the Broken Hill company had a certain number of orders to complete, but that as no further orders were being received the probabilities were that the works would be closed down in the course of a few weeks. He explained that a considerable proportion of the country's output was in merchant bars, for which the company's present price was £16 10s. per ton, whereas the same steel could be landed in Australia from Great Britain at £14 14s. per ton. The closing down of such an industry is an indication that a reduction in the cost of manufacture is the prime necessity, if the country's secondary industries are to compete with importations. This view of the situation is evidenced by the slump in B. H. P. share values, prices having dropped from 65s. a few months ago to approximately 25s. recently.

CALIFORNIA

Jo Rand Smelting Project Considered Impracticable—Drainage Adit at Grass Valley Talked of Again

San Francisco Correspondence

San Francisco—Snowfall conditions in the upper Sierras are such as to predict a plentiful water supply during the ensuing year. The total snow at Summit registers 186 in., with corresponding amounts along the crest of the Sierras.

At Grass Valley, the possibilities of a long adit from the Bear or Yuba river for drainage and prospecting purposes are under discussion again, but an engineer long familiar with the conditions in that district doubts the economic need for such an adit and states that the subject has been under discussion many times before without tangible results. Until more definite action takes place the project must be looked upon as improbable.

The announcement of the incorporation of a new company in California, the Jo Rand Smelting Co., which purposes building a custom smelter at Mohave, Cal., has been followed by the statement that Bela Kadish is president of the company and that the office of the company will be in Bakersfield, Cal. Mining men are not impressed with the practicability of a custom smelter at Mohave. The restricted water supply, the difficulty of securing a supply of coke, and the absence of sufficient amounts of lead ore, as well as the relatively small ore tonnage, available, are pointed out as difficulties. The fact that a custom smelter at Needles, Cal., was not a particular success casts doubt upon the future of the new project.

The Lewiston Gold Dredging Co. has been recently incorporated to work the Martin property near Lewiston. It is stated that the Valdor dredge recently shut down will be dismantled and moved to the property of the Lewiston Gold Dredging Co.

From the Mother Lode region reports emanate that the Maloney Mining & Milling Co. is to begin operations at Mokelumne Hill, and that the Easy Bird mine, in the same district, will be reopened within a few weeks. The Moore mine, as recently announced, will construct a twenty-stamp mill and erect an electric hoist. A report is current that the Hardenburg mine is to be reopened under a lease and bond.

At Randsburg, the Yellow Aster is diamond drilling with a view to finding extensions and new ore horizons. Five stamps are being operated for leasers, and thirty stamps are on ore from the vicinity of old workings. The California Rand is shipping six tons of concentrates and 100 tons of ore daily. At the neighboring Coyote mine, encouraging ore shipments have been made.

The Union Hill mine, a hydraulic mine at Douglas City, Trinity County, will resume work when the snow is off the ground.

Portola—The Walker, Berdsley, and Gruss mines are planning to resume.

NEVADA

Tonopah Divide Resumes Shaft Sinking —West End Announces Dividend— Blue Bird, at Hornsilver Sold

From Our Special Correspondent

Argentite — Despite deep snows, some development work has been accomplished at both the Francis and the Ecklund mines in the last few months. Each property now has a 200-ft. shaft, and drifts on the veins show good commercial ore. Preparations are being made for more active work during the spring and summer. The veins are large and well-defined and the district is regarded as one of promise.

Hornsilver—It is reported that the Blue Bird group, situated about 800 ft. from the Orleans Hornsilver mine, owned by Goldfield men, has been sold to Pittsburgh operators and that active development will be started before the end of April.

Divide—Shaft sinking has been resumed at the Tonopah Divide mine and the shaft is now 1,350 ft. deep. No water has been encountered. During the week ended March 29, 134 ft. of development work was accomplished. March production was heavier than usual, and was about 1,800 tons of $30 ore.

Eureka—Owing to prompt action by J. F. Shaughnessy, chairman of the Public Service Commission, the washout on the road between Palisade and Eureka has been repaired, and train service will be resumed at once.

Tonopah—The West End Consolidated Mining Co. in a letter to stockholders dated March 31, has announced that dividends of 20c. per share will be paid the coming year. The letter states that the dividend is made possible by the improvement in general conditions and the company's important reserves of ore. The MacNamara Crescent Mining Co., owning ground to the south of the West End, is resuming work on its 1200 level.

Ely—Gradual resumption of mining, milling and smelting by the Nevada Consolidated Copper Co. is definitely assured. There are many idle men now in Ely, and a further influx of labor is being discouraged.

Operations in Pioche District

BY E. C. D. MARRIAGE

Pioche—Settlement assays, received on April 4, on shipments of ore from the Comet district were as follows: Lyndon mine, first-class ore, 222.6 oz. silver and 9.4 per cent lead; second-class ore, 49.5 oz. in silver and 3.7 per cent in lead. Stella mine, first-class, 195.5 oz. in silver, 18.9 per cent lead; second-class, 64.1 oz. in silver and 16.2 per cent lead. The shipment totaled forty-two tons and will bring a substantial return.

The Bristol Silver Mines Co. and the Black Metals, Inc., both controlled by the Snyder interests, of Salt Lake City, continue to ship two cars daily. Mine conditions are satisfactory.

Among the companies recently incorporated is the Adra Mines Co., formed for the purpose of developing silver properties in the Silver Park district, forty-five miles north of Pioche. Twenty-three claims are owned by the company, three of which are patented. Three more patented claims are held by the company under lease and bond.

The Prince Consolidated Mining & Smelting Co. still continues to ship oxidized lead-silver ore from its upper levels. The company's railroad is not being operated, the ore being hauled by trucks to the main line at Pioche, a distance of about five miles.

UTAH

Bingham Canyon More Active—Magna Plant to Stay Down—Shipments From Park City and Tintic

From Our Special Correspondent

Salt Lake City—With the resumption of operations by the Utah Copper Co. the camp of Bingham, almost deserted for a time, is beginning to take on a new aspect. Production by the company is starting on a small scale and will probably gradually be brought up to the output of the period immediately prior to the shutdown, or about 50 per cent of capacity. The Arthur mill alone will be used as it was during the last months of production. The highest capacity of this plant is 10,000,000 to 11,000,000 lb. of copper monthly, and at the time of the shutdown it was producing 8,000,000 lb. a month. The Magna mill of the Utah company at Garfield, a table concentrating plant and not as modern as the Arthur mill, in which flotation has been installed, will not resume operations at present.

Alta—The Alta Tunnel and Transportation Co. is hauling its ore part of the way down the canyon by means of sleds, and stockpiling until such a time as the roads are open to teams the rest of the way down the canyon to the smelter at Murray.

Eureka—Ore shipments from the Tintic district for the week ended March 31 were 150 cars. Shippers were: Chief Consolidated, 44 cars; Tintic Standard, 38; Iron Blossom, 15; Colorado, 12; Eagle & Blue Bell, 12; Victoria, 12; Swansea, 4; Centennial-Eureka, 4; Alaska, 3; Bullion Beck, 2; Gemini, 2; Dragon, 3—two cars of ore and one car of fuller's earth; Grand Central, 1.

Park City—Shipments for the week ended March 25 amounted to 2,368 tons. Shippers were: Judge companies, 1,248 tons; Silver King Coalition, 645; Ontario, 475.

Shipments for the week ended April 1 were: 2,285 tons. Shippers were: Judge companies, 1,027 tons; Silver King Coalition, 570 tons; and Ontario, 688 tons.

WASHINGTON

Northport — Since resumption of operations at the property of Gladstone Mountain Mining Co., ore is being taken out from No. 5 chimney of the mine.

MONTANA

Anaconda Starts High Ore and Anaconda Mines—Hoist Breakage Shuts Down Steward Mine

BY A. B. KEITH

Butte—The High Ore mine of the Anaconda, one of the larger copper properties of the Butte district and the deepest mine in Butte, has resumed production together with the Anaconda mine, the resumption following rapidly upon the temporary suspension of activities at the Steward mine in consequence of the shafting of the hoisting engine breaking, which will necessitate a shutdown for five or six weeks. About 400 men were afforded employment at the Steward, and they were transferred to the High Ore and the Anaconda. The supply of experienced miners still continues lamentably small, and the wonder is where they all have gone. Nevertheless, it is said that there are employed at present in the Butte district more men than before the shutdown of the copper mining industry more than thirteen months ago. But many of the present employees are inexperienced men sandwiched in between old-timers.

The North Butte has not resumed, and neither has the Davis-Daly, nor the Tuolumne, and the East Butte is working approximately the same number of men it always had. The Anaconda is making all preparations to get back to a normal output of copper as quickly as is possible, and, furthermore, when that normalcy has been regained, to embark upon a program of ore development in the Butte district of materially greater extent than has been the rule. It is quite possible that this program may be launched before the copper-metal markets have regained their equilibrium.

More than 900 men are working in Anaconda's B. & M. smelter at Great Falls, and this number will continue to be increased as business justifies, until the entire works are running full blast. The zinc plant is reported operating at capacity now, turning out between 9,000,000 and 10,000,000 lb. of zinc monthly, this output having been reached within the last few days. The copper refinery is working at about 60 per cent, and is turning out 12,000,000 lb. of copper monthly, as against a capacity of 18,000,000 lb. The rod and wire mill is running at 50 per cent of capacity, and operations here will be increased steadily. The output of this plant is being put out over the West. About 11,000,000 lb. of Great Falls copper wire has gone to Chile and Peru.

The Washoe smelting works at Anaconda have coal stocks ample to care for the needs of plant for more than sixty days, and the works at Great Falls have a three months' stock.

The Hesperus Mining Co. has been refinanced, and the unwatering of its shaft on the Hesperus claim, south of the Davis-Daly's Colorado mine, has begun. Active development work will be undertaken. The company has opened more than 1,000 ft. of drifts.

IDAHO

Cœur d'Alene District

Advance in Lead Causes Optimism—Tamarack & Custer and Gold Hunter May Resume—Stewart To Be Worked

BY A. J. DUNN

Wallace—The recent advance in the price of lead from 4.70c. to 4.90c. has had a most stimulating effect upon the mining situation in the Cœur d'Alene district. Though three of the larger producing mines have continued in uninterrupted operation throughout the long period of depression, the credit is due to the fixed price of silver and to a commendable disposition on the part of these companies to give consideration to the welfare of the people of the community in which they operate. With a strong market for lead and with an upward movement of the price that promises to reach 5c. soon, and possibly better, at least two other mines are expected to be on the active list again after being down for more than a year. These are the Tamarack & Custer and the Gold Hunter. Though no official information has been given out, apparently reliable reports indicate that the first will be in operation before May 10. The Gold Hunter will probably wait for lead to reach 5c. This will leave the Hercules and Callahan the only big producers still idle. There are no indications of a resumption at the Hercules, and the future of Callahan is even more uncertain, as its chief product is zinc.

A recent announcement by the president of the Stewart Mining Co. states that the old Stewart mine will be further developed. Expectation of uncovering sufficient ore to warrant continuous operation is expressed, and also hope that by the time the metal markets have recovered the company will be shipping ore. The Stewart is near Kellogg, and for many years was a steady dividend payer. The announcement also stated that the Nabob, on Pine Creek, which is controlled by the Stewart, would also be active, and that negotiations were pending for the consolidation of some of the adjoining properties and handling all ore by the Nabob mill.

The Western Union Mining Co., operating near Wallace, is installing a five-drill Ingersoll-Rand compressor to be driven by electric power, preparatory to carrying out an extensive plan of development. Since striking a rich lead-silver ore shoot in November, 1920, steady shipments have been made by leasers, the aggregate value of shipments to date as shown by smelter returns being $90,000.

The Federal Mining & Smelting Co. has purchased from N. C. Sheridan, mining engineer of Wallace, the Midnight claim, which is practically surrounded by the Morning group of claims, owned by the Federal. Besides the known and prospective mineral value of the Midnight, the purchase removes a possibility of apex litigation. The price paid was $25,000 cash.

COLORADO

Coal Production Exeeds Sales Despite Strike—River Smelting & Refining Co. to Resume

From Our Special Correspondent

Denver—The end of the first week of the nation-wide strike of coal miners finds Colorado operators producing more coal than can be sold within the state, and unless an outside market can soon be found, production must be curtailed.

The properties of the American Smelting & Refining Co., and the Colorado Fuel & Iron Co. are operated as non-union mines and were not appreciably affected by the walk-out on April 1. There are at present more miners than jobs, and operators say that they are in a position to supply all the coal necessary for the mid-mountain territory as well as the plains region extending to the Missouri River.

The lack of orders is due chiefly to the fact that most of the large consumers laid in a large supply of coal in anticipation of the strike, and the warm weather has greatly reduced domestic consumption, and in many instances operators are faced with accumulating demurrage charges on account of a lack of market for the coal in cars.

Officials of the Colorado Fuel & Iron Co. announce that operations at the steel mill have been increased 30 per cent during the week, so as to make profitable use of the surplus coal produced by the company.

Florence—The River Smelting & Refining Co., which operates a zinc-oxide plant near this city, announces that it will at once resume operations, furnishing employment to 150 men. The plant has been closed for more than a year, and during this time has been overhauled and remodeled. It will treat about 100 tons of ore daily, obtained principally from Leadville. The product will be a zinc oxide and a matte carrying silver.

Cripple Creek—Development work is increasing throughout the Cripple Creek district and labor is becoming more plentiful. Among the more important projects under way is the lateral from the Vindicator mine to the Roosevelt tunnel, which is nearing completion. The United Gold Mines Co. is continuing its diamond drilling campaign from its lower levels, with promising results. The tonnage shipped the past few weeks is increasing.

Ouray—The Welch-Worland Mines Syndicate, operating the old Wanakah, is driving a raise from the upper or third contact, exploring for a possible fourth contact above the large stopes which made the chief production of the mine. A 3 by 8-ft. Marcy roller mill has been ordered to increase the mill capacity and allow fine grinding for flotation.

Sam Fellin & Co. have abandoned leasing operations on the Neodesha, after more than two years of steady work. During that time some high-grade ore was extracted.

ARIZONA

General Engineering Co. to Erect Mill at Stargo Mine

From Our Special Correspondent

Phoenix—The Howard Silver Co., which has property in the Black Canyon district, about forty-five miles north of Phoenix, is to sink to 500 ft. and to erect a flotation and concentration mill. The vein under exploration is said to sample 20 oz., and shipments in carload lots have averaged 250 oz. H. O. Howard is in charge.

Jerome—Two stringers of solid glance have been struck in the southeast drift from the 600-level station of the Verde Central. The shaft now is approaching 100 ft. depth below the station. Four headings are being operated in addition to the sinking, and the shaft equipment is overburdened.

The lower workings of the Shea have been unwatered, and the property has had close inspection by Assistant General Manager I. B. Joralemon of the Columet & Arizona Mining Co. It is believed that the C. & A. will include the Shea in its local scheme of development, which already embraces the Verde Central and Gadsden.

Clifton—General Manager J. P. Hodgson of the Phelps Dodge Corporation's Morenci branch states that Arthur Crowfoot and four other members of his staff have been working for two months on plans for remodeling No. 6 concentrator so as to handle an additional 1,000 tons of ore a day. These plans, now largely in the pencil stage, will be forwarded the New York offices soon. Whether authority for starting work on the improvement will be forthcoming soon depends entirely on the copper situation. A force of expert masons, sent by Kellog & Co., of New York, has started on repairs of the big brick stack at the Arizona smelter, below Clifton. The first of the cracks appeared at the time of the big strike, in 1916, and is assumed to have come from too rapid cooling.

The General Engineering Co., of Salt Lake City, has been awarded a contract for erection of a 100-ton silver-gold mill on the Stargo mine, near Morenci. The property is managed by Michael Hannon, for years a prominent miner at Bisbee.

Miami—The International smelter has its three reverberatories working steadily, mainly on concentrates, and is believed to be making a larger production monthly than any other copper-reduction works in America at present. It is more than equaling its maximum product of the past. There remain in the bins much of the concentrate supply of the Miami company, and a large concentrate tonnage is coming from the Inspiration mill, in which fourteen of the twenty sections are being operated. Old Dominion and Iron Cap are sending concentrates from Globe, and ore is being received from the Superior & Boston. Inspiration has avoided litigation and has secured a clear right of way up Webster Gulch a mile to the new Porphyry shaft.

Bisbee—Calumet & Arizona, which has been shipping about 300 tons of ore a day to its Douglas smelter, is increasing the tonnage as the smelter ore pits are being cleared out. Soon it will be sending 1,300 tons a day.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Number of Mines Increasing, but Ore Output Is at Standstill — Eagle Picher Starting Three Mines

BY P. R. COLDREN

Joplin—One of the significant features in this district just now is that the number of operating mines is increasing steadily, yet the district's zinc and lead ore production is apparently at a standstill.

Since March 1, at least ten concentrators have started operation, some of which had been idle for more than a year, yet the weekly production of the district in zinc concentrates remains around 7,200 tons, and is even being reported as lower than this figure.

At one time about two years ago the weekly production, which is not to be confused with shipments, was reported as high as 17,000 tons. This was the peak, and it compared with an average of about 5,000 tons previous to the war. That production should now be only about 7,200 tons per week with more than eighty mines operating is considered locally as explainable only in one way—namely, that the poor prices of the past months have made it so necessary for operators to mine the cream of their ore that this cream has been virtually exhausted. They believe that it would be altogether impossible at present to run production up above 10,000 tons; that it would probably be extremely difficult to make it exceed 8,000 tons weekly.

In the last three months only three new mines of any consequence have been developed in this field, and beyond doubt many more than this number have been badly depleted.

For the first time in many months there are rumors of a shortage of miners in the district during the last week. Even if production has not materially increased, the greater activity of mines indicates that more men are employed. The Bank of Picher cashed checks for miners to the extent of $65,000 on April 1, which is more than for any other Saturday since early in 1920.

The Eagle-Picher Lead Co. will place three mines in operation in the near future that have been idle for more than a year. This will give this company four going mines out of the eight which it owns. The St. Joe and Vantage properties will also resume operations as soon as they succeed in obtaining leases. Only one or two companies have as yet received new leases from the government on Indian lands in Ottawa County.

NEW MEXICO

Operations Resumed by the Chino Copper Co.

Santa Rita—The Chino Copper Co. resumed operations April 1 upon receipt of telegraphic instructions by General Manager John M. Sully from Charles Hayden, New York, chairman of the board of directors. About ten days will be required for clean-up work preparatory to beginning actual mining operations. These will start April 10, when a unit of the mill at Hurley will resume. More than enough labor is available at present for all requirements. About 500 men will be put to work at Hurley and Santa Rita. This force will be increased gradually until the output has reached a 50 per cent capacity. Preference will be given to old employees in recruiting the working forces.

The Lordsburg district was the only one to ship copper ores in March. During January and February no copper ores were shipped. They began to move about the middle of March, and a total of 2,667 tons was shipped. Most of this was from the Eighty-five mine to the C. & A. smelter at Douglas, Ariz.

The El Paso & Southwestern railroad, which is controlled by the Phelps Dodge Corporation and which recently took over the Arizona & New Mexico R. R., running from Clifton, Ariz., to Hachita, N. M., has put into effect new rates on crude ores from the Lordsburg district of New Mexico to the smelters at El Paso, Texas and Douglas, Ariz. The new rates became effective March 30, 1922.

MINNESOTA

Iron-Ore Prices To Be Fixed Soon, It Is Anticipated

Duluth—Iron-ore prices for the 1922 season have not as yet been set, but indications point to an announcement in the near future. Many of the blast furnaces are pressing the iron-ore operators for quotations for this coming season, but it has been the desire of producers to await the decision of the Interstate Commerce Commission relative to the adjustment of freight rates from mines to the dock. It is anticipated that this decision will be rendered by the middle of April, and that soon thereafter the producers will be in a position to quote prices on iron ore, which should not be later than May 1. It is also anticipated that the Lake freight rate this coming season will also be quoted at a lower figure.

MICHIGAN

Gogebic Range

Ironton and Colby Mines Preparing to Reopen Soon

Ironwood—The Ironton mine, at Bessemer, is preparing to reopen soon with a large force of men. The Colby mine likewise will probably be reopened. Both mines are operated by the McKinney Steel Co. and were recently visited by Mr. McNeil, the district manager.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
6	12.40@12.50	28.625	29.375	4.90	4.70	4.825@4.90
7	12.50@12.625	29.25	30.00	4.90@5.00	4.70@4.80	4.85@4.90
8	12.625	29.50	30.375	5.00	4.80@4.85	4.90
10	12.625	30.125	30.875	5.00@5.10	4.80@4.90	4.90
11	12.625	29.75	30.375	5 00@5.10	4.80@4.90	4.90
12	12.625	29.50	30.25	5 00@5.15	4.85@4.90	4.90

*These prices correspond to the following quotations for copper delivered: April 6th, 12.65 @ 12.75c.; 7th, 12.75 @ 12.875c.; 8th to 12th, inc., 12.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
6	58⅜	59⅛	63½	144½	145¾	21⅞	21¾	26	26
7	58⅞	59⅝	64½	147	148¼	22	21½	26⅛	26⅛
8	...	...	...	.....	.....	...	...	...	..
10	59¾	60½	64½	152½	153¾	22⅜	21⅞	26⅜	26⅜
11	59	59⅝	64½	150¼	151¾	22¾	22¼	26½	26½
12	58¾	59½	64½	148¼	149¾	22⅝	22¼	26½	26½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
6	438	99⅝	65¾	33⅝	10	441½	99⅝	65¾	33½
7	438⅜	99⅝	65⅞	33¾	11	440½	99⅝	65⅝	33½
8	439½	99⅝	65⅞	33¾	12	441	99⅝	65¼	33¼

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 12, 1922

A much more optimistic feeling is noticed among the metal producers and selling agencies. Demand for almost all of the metals has improved recently, and there is less of a tendency for weakly held stocks to appear on the market. Manufacturing interests generally are finding business better, and these improved conditions are being reflected in the raw-material markets. The advance in the stock market seems definitely established, and this has also made for optimism, though, of course, it is only a reflection of better business prospects. The coal strike is not yet taken seriously, though it seems to be slowly spreading to non-union ranks.

Copper

The copper market took a rather violent turn for the better last Thursday; in fact, it seems that the cheap supplies had been pretty well absorbed by Wednesday morning. Producers began taking orders at the advanced prices the next day, and soon all of the available metal for sale at 12.75c. delivered had been taken up, the larger producers meanwhile generally advancing from 12.75 to 12⅞ and 13c. During the last three days two or three producers have been willing to book desirable business at 12⅞c. delivered, but there is a marked tendency to come to the 13c. price; in fact, some has been sold at the higher level. On the other hand, one producer offered a large block of copper today at 12.75c. June to August deliveries have been in the greatest demand, not a great deal of prompt copper having been marketed. Sales have not been large, though a fair domestic business has been done.

Export demand has been moderate at advanced prices. The general quotation by the Copper Export Association for European delivery is now reported to be 13¼c., although outside interests report difficulty in getting so high a price. The import duty on copper to Japan was raised from 0.4c. to 2.5c. on March 29, so that exports to that country have temporarily ceased.

Lead

On Friday, April 7, the official contract price of the American Smelting & Refining Co. was raised from 4.90 to 5c., New York.

The lead market has been decidedly unsettled during the last week, with a big demand, which most producers have been unwilling to meet. The recent advance seems to have scared consumers into a desire to provide for future requirements, and as producers are not in the habit of selling for more than thirty to forty-five days in advance, these consumers have been anxious to buy prompt lead and hold it for future use. Some has no doubt been so sold against producers' wishes and has created an embarrassing shortage of April metal. It is felt that an undue advance in prices at this time would be bad for the trade, especially if much forward metal were sold, for it would likely be followed by a reaction later. However, there is no denying the existence of an improved demand for lead products, and if the price advance can be held within bounds, lead producers seem destined for an excellent spring and summer business.

Sales have been large during the last week, and practically all of those made by producers have been within the range of prices shown in the table on this page. However, there have been some quotations on a higher basis by unwilling sellers and by those who have been guided by what they believe the market might be rather than by facts. Quotations as high as 5c., St. Louis for common lead, have been made; in fact, desilverized has actually been sold at this price, a slight premium still being obtainable for that grade. In New York, old customers are able to obtain lead at 5c. for prompt shipment from the West, but buyers of odd lots from various producers are having great difficulty finding any metal for less than 5.15 to 5.25c.

Zinc

Demand from galvanizers has been quite active, and the price has stiffened further. It is understood that statistics to be released by the American Zinc Institute on Saturday are highly favorable, both as to shipments during March and as to tonnage on hand. This has encouraged producers and helped to establish the stronger prices. The only fear now is that the coal strike may, in time, cut down steel activities in the Pennsylvania, Ohio and Indiana districts. Demand in the last few days has been principally for forward zinc, May and June deliveries being particularly popular. Premiums of from 2½ to 5 points per month are being asked on such business. Export business has been placed with Japan.

High-grade zinc has been in good demand at unchanged prices—viz., 6c. delivered, where the delivery charge does not exceed 30c. per hundred pounds. Occasionally, some interests seem disposed to cut this price, but it is reported to hold for most business, nevertheless. The spiegeleisen market has been active at unchanged prices.

Tin

The price of tin advanced on Friday after an active demand. At the higher levels prevailing since that day, demand has fallen off perceptibly, and there seems to be a gradual softening of the market. It is reported that the advance in London was due partly to a desire to squeeze the shorts. Large arrivals recently have not had a particularly bullish effect. American electrolytic tin is in somewhat freer supply than for a time; it has sold on the same basis as the best grades of Straits.

Tin for forward delivery is also quiet at practically the same prices as are asked for spot. In some instances ¼c. premium has been charged for July deliveries.

Arrivals of tin in long tons: April 4, China, 150; Straits, 5; 5th, Straits, 15; 7th, Straits, 600; 10th, Liverpool, 35; London, 50; Straits, 75.

Gold

Gold in London: April 6th, 95s.; 7th, 94s. 9d.; 10th, 93s. 9d.; 11th, 93s. 5d.; 12th, 93s. 5d.

Silver

The market has been quiet recently, with a somewhat weak tendency. This is due undoubtedly to the approaching Easter holidays, with the consequent lack of business in London and the Far East. Fundamental conditions remain unchanged, with the market dependent upon China.

Mexican Dollars—April 6th, 50¼; 7th, 50¼; 8th, 50½; 10th, 50½; 11th, 50¼, 12th, 50¼.

Foreign Exchange

Political developments in their relation to the Genoa Economic Conference have influenced the foreign exchange market during the last week, but rates have generally been firm. On Tuesday, April 11, francs were 9.22c.; lire, 5.42c.; marks, 0.3525c.; and Canadian dollars, 97.625c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50@5c. for the week. Market has improved steadily, and it is difficult to obtain metal under 5c. today.

W.C.C. brand, 5¼@5¾c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—Somewhat weaker at 6.5@7c. Some dealers asking up to 7.5c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $50. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 8—Zinc blende, per ton, high, $31.10; basis 60 per cent zinc, premium, $29; Prime Western $29.50@$28; fines and slimes, $27@$25; average settling price, all grades of blende, $26.85.

Lead, high, $65.95; basis 80 per cent lead, $68@$70; average settling price, all grades of lead, $63.92 per ton.

Shipments for the week: Blende, 9,493; lead, 2,083 tons. Value, all ores the week, $387,410.

Blende with iron content received the highest basis offering for the week. Ore production has been purchased ahead of production for the past two weeks.

Lead demand became acute late today, with ore selling up to $70 basis, in competition to secure a few ore reserves accumulated recently.

Platteville, Wis., April 8—Blende, basis 60 per cent zinc, $29. Lead, basis 80 per cent lead, $66 per ton. Shipments for the week: Blende, 702; lead 39 tons. Shipments for the year: Blende, 4,024; lead, 680 tons. Shipped during the week to separating plants, 345 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

The prices of **Copper Sulphate, Sodium Nitrate, Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferrovanadium** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Zinc Sheets,** and **Yellow Metal** are unchanged from the issue of April 8.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of April 8.

The Iron Trade

Pittsburgh, April 11, 1922

The coal strike, chiefly by reason of its extension into the Connellsville region, non-union during its entire existence, has brought about an almost complete suspension of trading in pig iron and steel. The steel mills are well stocked with coal and operations would not be impaired, at least for a while, on account of coal shortage, but the sharp decrease in Connellsville coke supply is a factor that was largely unexpected.

The looked for $3 a ton advance in sheets is now effective, with black at 3.15c., galvanized at 4.15c., blue annealed at 2.40c., and automobile sheets at 4.50c. Wire nails are up 10c. a keg to $2.50, a corresponding advance being made in staples and barb wire, but none in plain wire or fencing. Bars, shapes and plates are generally quotable at 1.50c.

Pig Iron—Sellers are hard to find, and the market is up at least $1 on foundry and basic and 50c. on bessemer, producers hoping that prices will advance to what they consider their cost, against the time when they will feel free to sell. We quote the market as not under $20 for bessemer and foundry and $19 for basic, f.o.b. Valley furnaces.

Steel Corporation—The Steel Corporation's unfilled obligations increased by 353,079 tons during March, which, with heavier shipments, indicates bookings at close to capacity, the largest bookings since May, 1920.

Coke

Connellsville—Furnace, $3.50; foundry, $4.25@$4.75.

Conditions in the World's Zinc Industry Improving*

SINCE my last review, quotations of the London Metal Exchange have varied between £27 and £24 per ton, and at time of writing the London market stands at £25 7s. 6d. for spot and £25 10s. for three months. For reasons set out in later paragraphs I consider slab zinc to be cheap at anything below £26 for the next few months.

United Kingdom.—After negotiations between the Board of Trade and the representatives of the British smelters, the former agreed to make 40,000 tons of Australian zinc concentrates available to the British works at a price of 75s. per ton c.i.f. As the grade of the Broken Hill material is 47 per cent Zn, 6 per cent Pb, and 10 oz. Ag, the price mentioned is equivalent to a government subsidy to the British zinc industry and is more than 20s. per ton below the market value of other zinc ores in Europe. As the ocean freight for cargoes has ranged between 45s. and 51s. 3d. per ton, it follows that the Board of Trade has incurred a heavy loss in agreeing to supply the 40,000 tons at the price mentioned. Part of this lot has already been delivered and the remainder is on the water.

Subsequent negotiations between the British smelters and the government have been for the supply over a term of eight years. The terms upon which the Board of Trade are prepared to sign these long-term contracts with British works are highly attractive when compared with the government contract price with the Australian producers and also in comparison with the pre-war selling price of the Broken Hill material. The Board of Trade, however, is only prepared to deal on an f.o.b. Port Pirie, (Australia) basis, and as existing ocean freights are double the pre-war rates, the price concession is at least counterbalanced from the smelters' viewpoint. The first of such long-term contracts has already been signed, and notwithstanding the high freight, Broken Hill material imported under this contract is easily the cheapest source of zinc ore supply.

Several of the British smelters are running at part capacity, but for the time being the aggregate output hardly exceeds 2,000 tons per month. This will expand, however, and I fully expect to see the large plant at Avonmouth brought into operation before the end of the current year. Having regard to the good lead and silver contents of Broken Hill concentrates, it is essential for the British works to install a tabling plant to wash their retort residue, as the resultant washed residue-concentrate is easily salable on satisfactory terms. In my opinion the revenue accruing from the sale of this byproduct will represent the difference between profit and loss to several of the British smelters with low zinc markets.

Belgium.—The Belgian production is on a slightly higher plane than the average of 1921, as it is now in the neighborhood of 9,000 tons per month. Not more than 2,000 tons of this will find its way to the British market, and the rest will go to meet local demand, which is mainly for the rolling mills. The stock of sheet zinc in Belgium, which at one time during the last two years was of such huge dimensions, is now within ordinary limits and is no longer disturbing to the zinc situation.

The Belgium zinc smelters are not waxing rich and have been content to pay their way and make what little profit is possible on rolling. Their average cost of producing zinc is about £26 per ton, as compared with £19 10s. in pre-war days. Today's higher cost is due to the smelters being operated at only half capacity and to high wages and raw materials. Owing to the vagaries of the international exchanges, it is only practicable to make comparisons in terms of English sterling. Thus, today Belgian wages are 20 fr. as compared with 11s. in Britain and 75 marks (actually 1s. at today's exchange, 1,500 M=£1) in Germany. Against this, however, must be set the greatly increased efficiency of Belgian workers compared with the labor employed at British works and at the German and Silesian smelters. With regard to raw material Belgium is in the same situation as other countries which are entirely dependent upon imported ores. Outside the Vieille Montagne the purchase of ores is in the hands of a co-operative concern of which all the smelters are members. Several large contracts were made when slab zinc was at £40 and over, and naturally with a fall in the metal to below £26 these expensive ores have reacted harshly on the Belgians' producing costs.

Belgium has still many thousands of tons of Australian concentrates to take before it gets to the end of its high-cost contract ores. Coal in Belgium is about 78 fr., or four times the pre-war price of 18 fr., but having regard to the depreciated franc the present cost is equal to 30s. per ton as compared with 25s. in Britain. The Belgian producers emphasize their inability of competing with German smelters with German coal costing only 700 marks (say 10s. per ton). The Belgians are, however, viewing this aspect from an entirely wrong perspective, for though it is true that the official price of German coal is only 10s. a ton, if reckoned at today's exchange, the fact remains that there is a shortage of industrial coal for German industries. Moreover, the German and Silesian smelters find it uneconomical to import zinc ores, and the low-grade local material on which they have to rely makes for costly treatment and poor metallurgical recoveries. The factor which governs the whole situation, however, from a comparison point of view, is the over-all cost of producing a ton of zinc, and this is today £22 in Germany as compared with £26 in Belgium, France, and Britain.

The disability of the Belgian zinc industry as I see it is its future restricted outlet for its metal. It must be remembered that before the war England took 150,000 tons, or 75 per cent of the Belgian production of 200,000 tons. Today the British consumption of zinc is only 45 per cent of 1913, and when normality is restored the English markets will be almost entirely met by the 40,000 tons of electrolytic zinc acquired by the British government from Australia plus the production of the zinc smelters in Britain. Taking a long view of this position, I foresee such marketing difficulties for the Belgian producers as to throw them into the arms of a revived German Zinc Convention.

France.—The French smelters are operating at a capacity merely sufficient to meet domestic requirements, and the output does not exceed 30,000 tons per annum. These smelters in northern France are experiencing the same disabilities as the Belgian works, except that France, being a tariff and consuming country, can always adjust its duty to protect its own industries. Obviously, when Belgium at some future date is fighting for a marketing outlet for its slab zinc, the French smelters will be happier placed and, if pressed, will be granted readjustment of duty on imported metal, notwithstanding that to a large extent the interests which control the French works are also directly interested in Belgian zinc smelters.

Germany.—The German situation is unchanged, and the production of zinc at the German works and at the smelters in Silesia now within Polish territory is not more than the present consuming capacity of the country. The outlook at the Silesian works is still unsatisfactory, and production at that centre is on a small scale compared with the rated capacity.

Scandinavia.—The output of zinc in Norway and Sweden is today little more than the requirements of Scandinavian consumers. The electrothermic process has been developed to such a state of perfection that I place it next to the electrolytic process in economy of production, compared with the ordinary distillation methods which have to be employed where cheap hydro-electric power is unobtainable.

Australia.—The small distillation works at Port Pirie remain closed and are unlikely ever again to produce, considering the ability of the same interests to turn out high-grade zinc so much cheaper at the Risdon Electrolytic Works. The first half of the electrolytic plant in Tasmania

*A report by A. J. M. Sharpe, honorary member, to the American Zinc Institute.

is now producing 60 tons of 99.95 per cent purity zinc a day, and when the full plant is operating in six months' time the daily output will be 120 tons. As indicated in a previous survey, I have no reason to doubt the ability of the Risdon works, with its cheap hydro-electric power and other natural advantages, to produce zinc for £21 per ton when running at full capacity, and the company is in an advantageous position, inasmuch as it has sold its entire output up to 45,000 tons per annum to the British government until June, 1930, at a substantial premium over the London market price of g.o.b. zinc. Moreover, it is protected by possessing a minimum price for its zinc in the government contract, and would be capable of making satisfactory profits if the zinc market necessitated every other zinc smelter in the world closing down.

United States.—It is curious, but nevertheless a fact, that the unsold stock of zinc in the United States is the primary reason for the London price of zinc being £1 or £2 lower than it otherwise would be. When the American dollar began to depreciate and certain zinc interests looked to Europe as an outlet for part of their stocks the London metal people were confronted by American selling on an unwilling market. This has been the bogey of all optimistic dealers, who are afraid to back zinc for a rise if the improved sterling exchange in New York should tempt further selling by American holders. Similarly, the bears are unable to operate with any degree of safety with the market price standing below cost of production for fear of being caught short, and it is consequently the stock of United States zinc which is responsible for the absence of professional dealing in the metal on the London Metal Exchange. Though the American stocks are steadily diminishing, the monthly diminution is much smaller than the rate at which European stocks are disappearing, and as will be seen from a later paragraph I estimate the United States' unsold accumulation of zinc to amount to nearly 60 per cent of existing world stocks.

World Stocks of Zinc.—My estimate of virgin zinc stocks on March 31, 1922, is 97,000 tons, made up as follows:

	Metric Tons
United States	57,500
Germany and Polish Silesia	17,500
Britain	7,500
Belgium	3,500
Scandinavia	1,500
France	1,500
Australia (including quantities afloat to Great Britain and Japan)	4,000
Other Countries	4,000
Total	97,000

Estimated World Production for 1922.—At the beginning of January I prepared my usual annual estimate of world production of zinc and the details for 1922 were as follows:

	Metric Tons
United States	300,000
Canada	15,000
Belgium	100,000
France	30,000
Poland-Germany	125,000
Great Britain	45,000
Austria-Hungary, Jugo-Slavia and Czecho-Slovakia	12,000
Italy	1,000
Holland	3,000
Scandinavia	12,000
Spain	5,000
Australia	25,000
Japan	7,000
Total	680,000

Prophecy is more dangerous today than it has ever been in the metal industry, owing to the collapse in world trade which followed the Armistice boom. The above estimate has been based upon an anticipation of better conditions in the second half of this year, and should the industrial revival exceed expectations, and the world consumption prove greater than my estimated production of 680,000 metric tons, it will be an easy task for the most favorably placed smelters to increase their output accordingly. With one quarter of the year gone, I cannot but feel that I have been ultra-liberal in forecasting a production of 680,000 tons, particularly having regard to existing stocks.

Movements of Metals and Ores in February

Imports and exports of the more important metals and ores during February, as reported by the Department of Commerce, and the figures for February of last year, as finally revised, are as follows:

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds	February, 1921	February 1922
Copper		
Ore, concentrates, matte and regulus (copper contents)	(a)	1,180
Unrefined, black and blister	6,042	
Refined, in ingots and bars	60,147,053	48,676,879
Exported to		
United Kingdom	18,970,135	3,799,420
Belgium	3,444,807	4,466,146
France	10,242,746	10,494,459
Germany	20,725,169	14,302,424
Italy	726,715	3,083,672
Netherlands	1,098,607	2,969,089
Spain	1,125,681	392,818
Composition metal, copper chief value	2,187	1,840
Old and scrap	106,234	245,194
Pipes and tubes	207,017	85,823
Plates and sheets	498,113	1,320,290
Wire, except insulated	1,513,760	447,081
Lead		
Pigs and bars		
Produced from domestic ore	198,155	2,091,358
Produced from foreign ore	2,131,138	7,140,499
Exported to		
France	.....	2,240,972
United Kingdom	1,574,998	1,572,766
Canada	102,985	78,790
Argentina	224,000	120,878
Brazil	.....	280,141
China	4,076	.....
Japan	224,051	448,125
Zinc		
Dross	.....	2,976,652
Spelter		
Produced from domestic ore	263,460	593,286
Produced from foreign ore	(a)	(a)
Exported to		
United Kingdom	(b)	131,075
Japan	112,039	224,055
Canada	6,969	10,206
Mexico	118,027	3,892
In sheets and strips	498,225	390,428

IMPORTS

In Pounds, Unless Otherwise Stated

	February, 1921	February, 1922
Antimony ore, contents	149,507	.....
Antimony matte, regulus or metal	269,696	1,569,061
Copper		
Ore, contents	4,771,755	4,461,569
Concentrates, contents	5,065,744	.....
Matte and regulus, contents	743,112	619,928
Imported from		
Spain	5,795	746,799
Canada	81,833	.....
Mexico	3,319,340	49,807
Cuba	1,620,063	2,214,340
Chile	4,497,516	734,736
Venezuela	.....	506,676
Peru	.....	218,651
Other countries	1,058,064	610,488
Unrefined, black, blister and converter copper in bars and plates	19,424,907	18,081,802
Lead		
Ore, contents	440,197	1,129,523
Bullion and base bullion	47,350	6,767,282
Imported from		
Canada	239,687	174,818
Mexico	169,944	7,083,782
Chile	18,248	441,051
Other countries	59,668	197,154
Pigs, bars and old	2,000,895	111,963
Manganese oxide and ore, long tons	53,874	7,204
Imported from		
Brazil, long tons	36,450	.....
British India, long tons	14,800	.....
Other countries	2,624	7,204
Tungsten ore, long tons	50	8
Pyrites, long tons	3,600	25,970
Imported from		
Spain, long tons	.....	24,970
Other countries	3,600	1,000
Tin ore and oxide, long tons	1,167	2,757
Bars, blocks and pigs	5,269,969	9,294,901
Imported from		
United Kingdon	2,576,894	3,540,382
British Straits Settlements	2,316,937	5,236,649
Hongkong	126,207	40,305
Australia	11,200	40,320
Other countries	238,731	436,945
Zinc		
Ore, contents	2,968,835	63,480
Imported from		
Canada	452,687	28,500
Mexico	2,515,065	.....
Other countries	.....	34,980
Blocks, or pigs, and old	909,777	11,000

(a) No production, (b) No exports.

COMPANY REPORTS

Calumet & Arizona Mining Co.

A report of operations of the Calumet & Arizona Mining Co. for 1921 states that dividends totaling $1,285,043 were paid in that year. Net deficit was $694,878.81. Production amounted to 17,872,743 lb. of copper, 594,462.7 oz. of silver, and 14,000.6 oz. of gold. Statement of income and expenditures follows:

INCOME		
Total earnings on metals	$3,321,764.85	
Interest	257,784.10	
Other income	97,705.58	
		$3,677,254.53
EXPENDITURES		
Operating expenses, depreciation	$2,432,149.66	
Salaries, office, general expenses	201,014.09	
Freight, refining and marketing	446,715.88	
State and Federal taxes	692,247.35	3,772,126.98
Operating deficit		$94,872.45
Less ore depletion		600,006.36
Net deficit		$694,878.81

Balance sheet follows:

ASSETS		
Mining property account	$29,497,091.00	
Less reserve for ore depletion	7,987,205.96	$21,509,885.04
Options		11,000.00
Smelting plant	$3,099,079.39	
Less reserve for depreciation	1,530,475.50	1,568,603.89
Sulphuric-acid plant	$998,909.83	
Less reserve for depreciation	416,581.27	582,328.56
Other construction	$922,597.85	
Less reserve for depreciation	411,000.00	511,597.85
Construction at 85 Branch	$350,102.18	
Less reserve for depreciation	38,500.00	311,602.18
Investments (at cost)		
New Cornelia Copper Co. stock (1,229,741 shares)	$4,731,555.12	
Tucson, Cornelia & Gila Bend R.R. stock	425,000.00	
Gadsden Copper Co. stock	664,044.39	
Warren Co. stock	290,000.00	
Cochise County highway bonds	140,000.00	
Liberty Bonds	1,266,900.00	
U. S. Treasury certificates	200,000.00	
Other securities	559,733.54	8,277,233.05
Notes and accounts receivable		1,461,591.29
Supplies at mines and smelter		917,339.77
Cash		759,122.76
Metals on hand and in process		3,377,480.28
Items in suspense		141,543.33
Deferred charges to operations		523,404.23
		$39,952,732.23
LIABILITIES		
Capital stock authorized	$6,500,000.00	
Less unissued stock	74,780.00	
Outstanding stock		6,425,220.00
Notes and accounts payable		1,887,769.27
Reserve items		471,537.33
Surplus		31,168,205.63
Earned Surplus, Dec. 31, 1920	$5,096,187.38	
Deficit year 1921	694,878.81	
	$4,401,308.57	
Less dividends paid in 1921	1,285,043.00	
Earned surplus, Dec. 31, 1921	$3,116,265.57	
Paid-in surplus, Dec. 31, 1921	28,051,940.06	
		$39,952,732.23

Copper on hand estimated at 12½c. per lb. Copper on hand Feb. 1, 1922, amounted to 5,881,995 lb., exclusive of copper pledged to Copper Export Association.

Osceola Consolidated Mining Co.

A report of operations of the Osceola Consolidated Mining Co. for 1921 states that no copper was produced during the year. Loss for the year amounted to $426,440.24. On Jan. 1, 1921, 5,533,927 lb. of copper was on hand and on Dec. 31, 1921, 408,263 lb. Balance of current assets Dec. 31, 1920, was $2,796,232.10 and on Dec. 31, 1921, $2,314,003.57.

Ahmeek Mining Co.

A report of operations of Ahmeek Mining Co. for 1921 discloses a loss for the year of $457,033.83, as the following accounts show:

Copper production for the year (Jan. 1 to Mar. 31 only) ..... 6,255,200 lb.

PRODUCTION COSTS		Cents Per Lb.	Total
Mining		7.59	$ 474,570.09
Smelting and refining		2.02	126,559.83
Boston office and taxes		.68	42,551.10
Depreciation and depletion		4.27	267,127.14
Production cost of	6,255,200 lb. @	14.56	$ 910,808.16
On hand Jan. 1, 1921	17,003,646 lb. @	13.00	2,210,473.98
	23,258,846 lb. @	13.42	$3,121,282.14
Sold in year	13,366,746 lb. @	13.00	1,737,676.98
	9,892,100 lb. @	13.99	$1,383,605.16
Add to bring to market value			1,288.84
On hand Dec. 31, 1921	9,892,100 lb. @	14.00	$1,384,894.00

EARNINGS STATEMENT			
Received for copper sold	13,366,746 lb. @	12.86	$1,718,341.58
Cost of copper sold			
Production cost at 13c. per lb.	$1,737,676.98		
Selling and delivery cost at .57c. per lb.	76,008.57	13.57	1,813,685.55
Loss on copper sold		.71	$ 95,343.97
Gain by increase to market value as above			1,288.84
			$ 94,055.13
Maintenance costs (April 1 to Dec. 31)			
Mine		$186,283.71	
Boston office taxes		132,484.57	
Depreciation		21,027.58	339,795.86
Loss by sale of Liberty Loan bonds and Government copper		98,704.29	
Miscellaneous credits			
Interest and silver		75,519.45	23,184.84
Loss for year			$457,035.83
Capital assets increased			
Plant—New construction	$6,176.40		
Obsolescence	100.00		
		$6,076.40	
Real estate		1,200.00	
Net increase in capital assets			7,276.40
			$ 464,312.23
Increase in reserves for depreciation and depletion		$288,154.72	
Less decrease by obsolete construction		45.42	288,109.30
Decrease in balance of current assets			$ 176,202.93
Balance of current assets Dec. 31, 1920			3,255,677.97
Balance of current assets Dec. 31, 1921			$3,079,475.04

Engels Copper Mining Co.

The annual report of the Engels Copper Mining Co. for 1921 gives output of copper as 11,500,993 lb., valued at $1,440,319.99; of silver as 168,699 oz., valued at $167,692.22, and of gold as 1,422.7 oz., valued at $27,043.49. The net cost of copper production was 14.69c. per lb. The net receipts from concentrates delivered to and in transit to smelter, together with other earnings, was $1,037,388.97. The total operating expense was $1,088,555.34, leaving an operating deficit of $51,166.37. Reserves for depreciation and liability for compensation, less profit and loss, Dec. 31, 1920, and stock premium bring the total deficit up to $119,616.73 for the year. Capital expenditures for 1921 totaled $275,468.86. Ore reserves total 3,342,118 tons in the Engels and Superior mines. Development footage was 6,687.53 ft. (including diamond drill footage) in the Engels mine and 1,949.53 in the Superior mine. The ore tonnage milled totaled 306,024, averaging 2.224 per cent copper. The mill output was 19,829.9 tons of concentrates, assaying 29 per cent copper.

MINING STOCKS

Week Ended April 8, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	62	60½	62	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	4⅛	3⅞	3½	.....	....
Allouez	Boston	27¼	26½	27	Mar. '19	1.00
Anaconda	New York	53	51	52⅛	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2⅞	1 5/16	2⅛	.....	....
Ariz. Com'l.	Boston	9¼	9¼	9⅛	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*20	*15	*18	.....	....
Bingham Mines	Boston	13¼	13⅛	13⅛	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61	57½	60	Mar. '22, Q	0.50
Calumet & Hecla	Boston	280	275	279½	June '20, Q	5.00
Canada Copper	N. Y. Curb	*24	*21	*24	.....	....
Centennial	Boston	12	11	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	36½	35⅛	36	Mar. '21, Q	0.50
Chile Copper	New York	17⅞	17⅛	17½	.....	....
Chino	New York	28⅛	27⅜	27⅞	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*29	*29	*29	.....	....
Con. Arizona	N. Y. Curb	*3	*3	*3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1 5/16	1⅛	1¼	.....	....
Copper Range	Boston	45	42⅞	44	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	1⅛	1⅜	.....	....
Davis-Daly	Boston	8	7⅛	7⅛	Mar. '20, Q	0.25
East Butte	Boston	11⅜	10⅞	11⅛	Dec. '19, A	0.50
First National	Boston Curb	*85	*70	*80	Feb. '19, SA	0.15
Franklin	Boston	1⅞	1⅛	1⅛	.....	....
Gadsden Copper	Boston Curb	†*75	†*60	*65	.....	....
Granby Consol.	New York	27⅛	26	27	May '19, Q	1.25
Greene-Cananea	New York	29	26⅜	29	Nov. '20, Q	0.50
Hancock	Boston	2⅜	2⅜	2⅜	.....	....
Howe Sound	N. Y. Curb	3¼	3	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	41⅛	40	40⅜	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7	7	7	Sept. '20, K	0.25
Isle Royale	Boston	24⅛	24	24	Sept. '19, SA	0.50
Kennecott	New York	30⅛	29⅛	29⅛	Dec. '20, Q	0.50
Keweenaw	Boston	1⅛	1⅛	1⅛	.....	....
Lake Copper	Boston	3⅛	3	3⅛	.....	....
La Salle	Boston	1⅛	1⅛	1⅛	.....	....
Magma Copper	N. Y. Curb	29	28⅛	28⅛	Jan. '19, Q	0.50
Majestic	Boston Curb	*6	*6	*6	.....	....
Mason Valley	Boston	†2	†1⅛	1⅞	.....	....
Mass. Consolidated	Boston	2⅛	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	29⅛	27⅞	29	Feb. '22 Q	0.50
Michigan	Boston	2	2	2	.....	....
Mohawk	Boston	59	57	59	Feb. '22, Q	1.00
Mother Lode Con.	N. Y. Curb	8⅛	7⅞	8	.....	....
Nevada Consol.	New York	15⅜	14⅞	15⅛	Sept. '20, Q	0.25
New Cornelia	Boston	18	17	17⅞	Feb. '22, K	0.25
North Butte	Boston	13¼	12¼	12⅜	Oct. '18, Q	0.25
North Lake	Boston	...	...	*10	.....	....
Ohio Copper	N. Y. Curb	*9	*8	*9	.....	....
Old Dominion	Boston	25	24⅛	24⅛	Dec. '18, Q	1.00
Osceola	Boston	36⅜	34	36⅛	June '20, Q	0.50
Phelps Dodge	Open Mar.	†175	†165	...	Apr. '22, Q	1.00
Quincy	Boston	45⅜	43	45	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅛	14⅞	15⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*2	*2	*2	.....	....
St. Mary's Min. Ld.	Boston	46	44½	45	Dec. '21, K	1.00
Seneca Copper	Boston	13⅞	13⅜	13⅞	.....	....
Shannon	Boston	1.25	*85	1.00	Nov. '17, Q	0.25
Shattuck Arizona	New York	8⅜	8¼	8⅜	Jan. '20, Q	0.25
South Lake	Boston	†1.00	†*65	*80	.....	....
Superior & Boston	Boston	1	*90	1	.....	....
Tenn. C. & C. cfs.	New York	11⅞	11	11⅛	May '18, I	1.00
Tuolumne	Boston	*68	*60	*63	May '13,	0.10
United Verde Ex.	Boston Curb	28	26⅜	28	Feb. '22, Q	0.25
Utah Consol.	Boston	2⅛	1⅞	2⅛	Sept. '18,	0.25
Utah Copper	New York	66¼	63⅝	65½	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅝	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	†2	†1½	1⅞	.....	....
Winona	Boston	*60	*35	*60	.....	....
Wolverine	Boston	13¼	12½	13	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	17⅛	16⅜	17⅛	Mar. '19,	0.50
Internat. Nickel, pfd	New York	79	79	79	Feb. '22, Q	1.50
LEAD						
National Lead	New York	92⅞	90	90¼	Mar. '22, Q	1.50
National Lead, pfd.	New York	113	113	113	Mar. '22, Q	1.75
St. Joseph Lead	New York	14	13⅛	14	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1⅜	1⅛	1⅛	.....	....
ZINC						
Am. Z. L. & S.	New York	16	14⅞	14⅞	May '20,	1.00
Am. Z. L. & S. pfd.	New York	40⅞	39	40⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅜	6	6⅛	June '18,	0.50
Butte & Superior	New York	27⅜	26⅛	26⅝	Sept. '20,	1.25
Callahan Zn-Ld.	New York	7⅜	6⅛	6⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	145	143	143	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*45	*45	*45	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅛	1/32	⅛	.....	....
Alaska Juneau	New York	1⅛	1	1	.....	....
Carson Hill	New York	15½	15½	15½	.....	....
Cresson Consol. G.	N. Y. Curb	2 1/16	2⅛	2⅛	Jan. '22, Q, X	$0.10
Dome Extension	Toronto	...	...	*85	.....	....
Dome Mines	New York	26½	25¼	25½	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*20	*22	.....	....
Golden Cycle	Colo. Springs	*72	*72	*72	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*8	*7	*7	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.75	9.55	9.65	Mar. '22,	0.05
Homestake Mining	New York	70	69	69	Mar '22, M	0.25
Kirkland Lake	Toronto	*48⅛	*44	*45	.....	....
Lake Shore	Toronto	2.35	2.25	2.30	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	20.60	19.00	19.60	Jan. '22, K	0.05
Porcupine Crown	Toronto	*30	*26	*26⅛	July '17,	0.03
Porcupine V. N. T.	Toronto	*31	*27½	*31	.....	....
Portland	Colo. Springs	*32	*32	*32	Oct. '20, Q	0.01
Schumacher	Toronto	*57	*53	*53	.....	....
Silver Pick	N. Y. Curb	*21	*16	*16	.....	....
Teck Hughes	Toronto	*56	*40	*52	.....	....
Tom Reed	Los Angeles	*60	*51	*60	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1⅛	1⅛	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*16	*12	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*4	*4	.....	....
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅜	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36	*33½	*35	May '20, K	0.03
Coniagas	Toronto	...	...	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*18	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3½	3⅜	3½	Jan. '22, Q	0.12½
La Rose	Toronto	*40	*31	*33	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*24	*21	*22	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6¼	5⅜	6¼	Jan. '22, Q, X	0.30
Ontario Silver	New York	†8	†7	7⅜	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*40	*34½	*38	Jan. '20, K	0.04
Trethewey	Toronto	*4	*3⅜	*3⅜	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*31	*20	*25	.....	....
Cash Boy	N. Y. Curb	*5	*4	*4	.....	....
Dolores Esperanza	N. Y. Curb	1⅛	1¼	1¼	.....	....
El Salvador	N. Y. Curb	*5	*4	*4	.....	....
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	...	...	*4	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*9	*6	*9	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅜	1 5/16	1⅜	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*69	*60	*68	.....	....
Tonopah Extension	N. Y. Curb	1⅛	1 7/16	1⅛	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅜	1⅛	1⅜	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1 1/16	1⅛	1 1/16	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	†1.00	†*93	*93	Dec. '20,	0.15
Chief Consol.	Boston Curb	3 1/16	3⅛	3 1/16	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20	20	20	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.50	†1.50	...	July '20, Q	0.10
Daly-West	Boston	2⅛	1⅞	1⅞	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†⅜	†2⅛	2⅛	Apr. '21, K	0.05
Electric Point	Spokane	*6	*5½	*6	May '20, SA	0.03
Federal M. & S.	New York	11	11	11	Jan. '09,	1.50
Federal M. & S. pfd.	New York	40⅜	38½	40	Mar. '22, Q	1.00
Florence Silver	Spokane	*24½	*24⅛	*24½	Apr. '19,	0.01½
Grand Central	Salt Lake	*54	*53	*54	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5⅞	5⅜	5⅜	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*21	*21	*21	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	2.60	2.60	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*10	*6	*6	June '21, I	0.02
Prince Consol.	Salt Lake	*9	*8	*8¼	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*9	*10	.....	....
South Hecla	Salt Lake	†*60	†*35	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*17	*15	*17	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*12	*10	*11	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.25	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.97½	1.92½	1.92½	Dec. '21, Q	0.05
Utah Apex	Boston	3⅜	3⅛	3⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	45	39	44½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	58	55½	56½	Jan. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	78½	77½	77½	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	18⅜	16⅞	18⅛	Nov. '19, Q	1.00
Texas Gulf	New York	42	40½	41½	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	57⅞	53½	57½	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	98½	97⅜	97¾	Mar.'22 Q	1.75
Am. Sm. Sec. pf. A.	New York	91	91	91	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	38⅛	36¾	38	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	47	46½	47	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

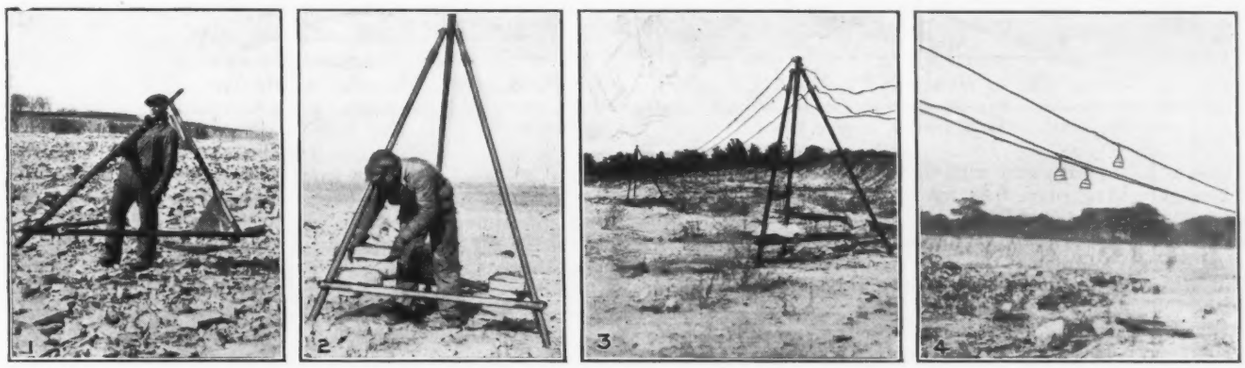
Suspending Temporary Electric Wires in Pit and Quarry

An Ohio stone quarry is making use of portable racks or standards for carrying electric wires used in blasting. The rack is about six feet high, weighs less than one hundred pounds and can easily be handled by one man. Where several are used they are placed from fifty to seventy-five feet apart.

The rack, consisting of three uprights that are braced at the base, is constructed of black iron pipe with a coating of black insulating paint, or of galvanized pipe. At the top the uprights are bolted together so as to form a tripod. Each upright is equipped with a short insulating sleeve and a porcelain knob insulator. The bolts holding these knobs in place are carefully insulated from the upright metal. A ballast plate is fitted on each base angle of the triangle so that boulders or other weights may be used for keeping the rack from being upset or blown over.

Wires as large as No. 4 stranded can be wrapped once around the porcelain knob, thus avoiding the necessity of tie wires.

For the amount of current required by a blast drill hole of 220 or 240 v., the Hubbell weatherproof composition attachment plug has proven satisfactory. Both wires of an attachment plug base are soldered to each of the power wires. Likewise, both poles of an attachment plug "cap" are attached to each wire of the cable leading to the portable electrical machine. The racks are made by the France Foundry & Machine Co., of Toledo, Ohio.



Portable racks for carrying electric wires

1. *Carrying rack.* 2. *Placing standard for use.* 3. *Wires suspended from racks.* 4. *Sockets on wires.*

Mill Wreckage Cleared With "Little Tugger" Derrick

An inexpensive derrick was constructed and successfully used to clear away the debris caused by a fire that partly destroyed the 600-ton mill of the Silver King Coalition Mines Co. at Park City, Utah recently. Two "Little Tugger" hoists were utilized in the construction of the derrick. Originally they were operated in the company's mines and had been purchased for underground usage only.

The following is a description of the derrick and the work: The mast and the boom were made from telegraph poles. The mast is pivoted at the foot and held by guy ropes at the top. The boom is pivoted at the lower end of the mast. A rope is connected with the upper hoist and passes over a sheave at the top of the mast, through a pulley, and another pulley attached to the mast head at the top of the boom. This rope varies the angle of the boom.

The hoisting rope is connected with the lower hoist and passes under a sheave on the mast, over another sheave on the boom, and through two pulleys, one attached to the end of the boom and the other suspended from it. This is the rope which suspends the load.

The derrick is swung by hand, although if a bull-wheel were furnished another "Little Tugger" could do this work also.

The photograph shows the derrick in action. One-half of a Marcy mill has just been lifted clear of the ground.

Salvaging mill wreckage with small hoist

The Hundrieser Rock Drill

The scope of electrically operated, rotating rock-drilling machines has been somewhat extended by the invention of a new rock drill, a short description of which follows:

Most of the drills that have been used for the working of medium hard rocks, such as coal, potash, gypsum, chalk, and slate, comprise two cylindrically arranged uniform edges, whereas the Hundrieser breaking drill, in contradistinction, is shaped as shown in Fig. 1, page 656, with its edges arranged eccentrically, thus insuring a partial breaking of the material to be drilled. About 60 per cent of the boring dust is made up of small grainy fragments, whereas that of standard drills is of a mealy consistency. Owing to this breaking effect, the amount of energy expended for a given length of bore hole is less than in the operation of the usual type of edge, savings up to 50 per cent being obtained. Moreover, the bore hole becomes perfectly cylindrical, with smooth walls, there being no deviation of bore holes.

When using the new type of drill, it is quite essential that any dulled drills should be properly reground. Special wet grinding machines are designed for this purpose, equipped with emery disks of proper shape. Inasmuch as the drill is made of high-grade 16 to 18 per cent tungsten steel, water cooling is of the utmost importance. The following data show the economical advantages to be derived from the use of the new drill:

In a potash mine about 1,052 meters of hard salt were drilled with twenty-four drills of the usual type. During the operation the drills were used up completely, their edges representing a purchasing value of about 800 marks. Fifteen Hundrieser drills were used in drilling 1,826 meters in the same hard salt and only one-third of the drills were worn out, corresponding to an outlay of 475 marks. The total cost in drilling 1,052 meters with the old type of drill amounted to 1,681 marks, whereas the outlay for the new type of drill (despite the greater boring length of 1,852 meters) was only 500 marks. One meter of bore hole, in using drills with the old type of edge, thus averaged

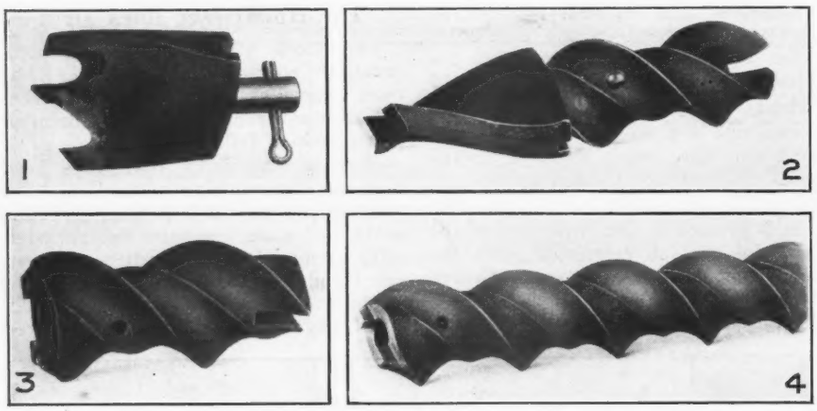


Fig. 1. Cutting edge of Hundrieser drill. Fig. 2. Drill in conjunction with intermediate piece. Fig. 3. Intermediate piece for use in conjunction with new rock drill. Fig. 4. End of boring rod prepared to be fitted direct

a cost of 1.70 marks and with the Hundrieser breaking edge, 0.28 mark. To this should be added the further advantage of about 50 per cent saving in electrical energy. Moreover, the Hundrieser drill insures a higher speed of working. With the old type of drilling edge twenty-three holes of 29.60 m. total boring depth and 45-42 mms. diameter were drilled in five hours and ten minutes, whereas with the Hundrieser drill twenty-three holes of 29.80 m. total depth and 42 mms. diameter were put down in three hours and twenty-five minutes. The drilling time per meter of hole when using the old type of drill averaged ten minutes and thirty seconds, and with the Hundrieser drill the average was seven minutes.

The advantages afforded by the Hundrieser breaking drill can readily be made use of anywhere, as most drilling rods can without difficulty be adapted to the new drilling edge.

Fig. 2 shows the drill in conjunction with an intermediate piece, the latter alone being shown in Fig. 3. The end of a boring rod of sufficient thickness, prepared for a Hundrieser drill to be fitted direct, is represented in Fig. 4.

INDUSTRIAL NOTES

The Combustion Engineering Corporation announces the opening of a new branch office at 1,137 Guardian Building, Cleveland, Ohio. This office will be in charge of Frank Henderson.

The Electric Furnace Co. has moved its general and sales offices from Alliance, Ohio, to Salem, Ohio. By this action all departments of the company will be consolidated at its works, Wilson St. and Pennsylvania Railroad, Salem, Ohio.

The Aztec Gold Mines Co., Baldy, N. M., will remodel its present milling plant and other equipment at an early date, and would be pleased to receive catalogs from manufacturers of crushing, amalgamating, concentrating, cyaniding and flotation machinery. The post-office address of the company is Ute Park, Colfax County, N. M.

The Metals Coating Co. of America, manufacturers and distributors of the Schoop Metal Spraying Process, by means of which metallic coatings of any kind may be sprayed on to any surface, is in full operation at its new plant, 495-497 N. 3d St., Philadelphia, having removed from the company's former Boston, Mass., and Woonsocket, R. I., locations.

In the *Journal-Press* of April 1, on p. 552, our correspondent stated that an installation of rotary car dumpers was being placed at the Odgers mine of the McKinnery Steel Co., Iron Mountain, Mich., and that the work was being done by the "Chicago Car Dumping Equipment Co." The correct name of the latter concern is the Car-Dumper & Equipment Co.

Sandvik Steel, Inc., announces the consolidation of the company's general steel and steel-belt conveyor departments in Suite 2,001, Woolworth Building, 233 Broadway, New York City. The following are the officers of this company: W. D. Thomas, president and general manager; Anders Johnson, vice-president; Garrick M. Spencer, secretary, and Harry Carlson, sales manager.

The Freeport Sulphur Co., of New York and Freeport, Tex., awarded a contract on March 24 to Dwight P. Robinson & Co. for the design and construction of a complete sulphur-mining plant at Hoskins Mound, Tex. Cloyd M. Chapman has been retained by the Freeport Sulphur Co. as consulting engineer. The company now operates a large sulphur mining plant at Freeport, Tex., consisting of four units which were built by Westinghouse, Church, Kerr & Co. (which has been merged into Dwight P. Robinson & Co.) in the period from 1913 to 1918. This plant contains one of the largest installations of oil-burning boilers in the world.

The new plant is one of several industrial undertakings recently awarded to Dwight P. Robinson & Co., and indicates the renewed activity that seems to be generally apparent in industrial construction.

TRADE CATALOGS

Mineral Specimens—George S. Scott, of 20 Nassau St., New York, has issued a twelve-page pamphlet which describes the characteristics of 125 mineral specimens included in collections for sale.

Steam Turbines—The Allis-Chalmers Manufacturing Co., of Milwaukee, Wis., has issued Bulletin No. 1,119 on "Steam Turbine and Alternator Units," covering high-pressure condensing units of 1,500 and 1,800 r.p.m.

Industrial Diamonds—J. K. Smit & Zonen, Amsterdam, Holland (U. S. agents, I. C. Van Itallie Co., 90 West St., New York), have issued an attractive fifteen-page pamphlet, which includes information on Brazilian carbons and borts (bortz) used for diamond drilling and other industrial purposes.

Recorders—The Uehling Instrument Co., of Paterson, N. J., has recently issued Bulletin 112, "Uehling CO_2 Equipment." Attention is called to the recently developed Pyro-porus filter, which is efficient in keeping the gas sampling lines clean. Other noteworthy features are the separate recorder for the engineer's office, an indicator for the boiler front continuous (not intermittent) chart record, and dry method of absorption.

Hammer-Weld Pipe—Until now not much hammer-welded steel pipe has been manufactured in this country, in comparison with the established types of welded, cast, riveted, and fabricated pipes. Considering the wide field for this material, and the particular advantages offered, Bulletin No. 13 of the National Tube Co., of Pittsburgh, Pa., will consequently be of interest. Hammer-weld pipe is particularly efficient for water lines, and offers distinct advantages where corrosive tendencies obtain, low friction loss, freedom from leakage, and ease of construction.

Reducing Valves—Most reducing valves, according to the Atlas Valve Co., of Newark, N. J., are needlessly large. Consequently, they are unduly expensive. The whole matter of reducing valve economics is fully covered in a new handbook just issued by the above-named manufacturer. The handbook goes into complete detail on all points that are closely connected with and vital to reducing valves. The flow of steam through pipes is handled in a simple manner. Charts and formulas are entirely eliminated. Handy tables make it possible for the user to determine at a glance just what a given pipe size will do. Also, the tables will enable the user to select the proper size of pipe needed for a given weight of steam per minute. Other features cover: Superheated steam; heavy pipe; pipe fittings; leaders to heating systems; pipe friction allowances and steam velocities. The manufacturers will send a copy upon request.